

Clinical Manual for Oral Medicine and Radiology

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Clinical Manual for Oral Medicine and Radiology

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Clinical Manual for Oral Medicine and Radiology

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*Dedicated
to
My Parents, Brother and Wife
—Ravikiran Ongole*

*and
My Parents, Wife and Daughter
—Praveen BN*

FOREWORD

I have great pleasure in writing to this foreword for the book “Clinical Manual for Oral Medicine and Radiology” by my students Dr Ravikiran Ongole and Dr Praveen BN.

The authors have taken tremendous pains in preparing this book, focusing attention on evaluation of various oral and facial abnormalities as well as basic aspects of dental radiology. They have maintained simplicity and readability that would help any beginner and expert alike enjoy reading and understanding.

This book has been very thoughtfully divided into 2 parts—Oral Medicine and Radiology, each of which has logical sequence of sections. The book has the principle of “small things add to perfection but perfection is not a small thing”. I congratulate Dr Ravikiran and Dr Praveen for this fine contribution and wish and hope the book finds the deserved use and popularity.

Dr Keerthilatha M Pai

Professor and Head
Department of Oral Medicine and Radiology
Manipal College of Dental Sciences, Manipal

FOREWORD

ORAL MEDICINE is a specialty that deals with study of diagnosis and medical management of oral soft tissue diseases, facial pain, oral diseases in medically compromised patients, diagnosis of systemic diseases on the basis of their oral and dental manifestations, and impact of systemic diseases on the tissues of oral cavity.

Many books are available as text and reference in the subject. However, there has been a need for a comprehensive manual, detailing the ways and means of collecting scientific information and its application in diagnosis and management of Oral disorders.

I am sure the book “Clinical Manual for Oral Medicine and Radiology” fulfills the need to a large extent. To address these shortcomings and with a view to helping students, Dr Ravikiran Ongole and Dr Praveen Birur have taken up the task of writing the manual.

The manual is specially prepared to help the students of undergraduate studies in Dentistry. Emphasis is laid on step-by-step examination protocol in the examination of each and every part of tissues in the oral cavity.

I am sure this manual will be very useful and handy for day-to-day reference in Oral Medicine, Diagnosis and Radiology.

Dr NS YADAV

Dean, Professor and HOD
Peoples College of Dental Sciences
Bhopal

PREFACE

This manual is intended to provide insight into the realms of the clinical aspects of Oral Medicine and Radiology to the student entering dental clinics for the first time.

In India, undergraduate students begin to interact and evaluate patients in the third year of the BDS curriculum. This manual will help the student in understanding the patient's orofacial complaints and the subsequent step-by-step examination of oral and paraoral structures. This manual also serves as a ready-reckoner for private dental practitioners, undergraduate and postgraduate students of dentistry.

The manual is made up of two sections, Oral Medicine and Radiology.

The oral medicine section describes history-taking for regular and special cases in great detail. It also prepares and sensitises the student to the needs of patients with certain physical or mental disabilities and individuals with underlying systemic diseases. In addition, the manual also describes a step-by-step clinical examination protocol for evaluating common orofacial problems like dental caries, periodontal diseases, lymphadenopathy, temporomandibular disorders, orofacial pain, oral precancers and cancers, salivary gland disorders and maxillary sinus diseases. The appendix contains a compendium of commonly used medications in dental clinics, which will help students and dental practitioners to use it as a ready reference while prescribing medications to patients. A chapter on management of common orofacial problems would help private dental practitioners to manage common orofacial diseases.

The Radiology section deals with traditional imaging techniques along with construction of the X-ray machine, processing and interpreting radiographs, and specialised imaging techniques of radiography. Detailed coverage of contrast radiography such as arthrography and sialography, scintigraphy, digital radiography and thermal imaging keeping in mind the



expanding horizons of the imaging modalities for the head and neck region follows. The Appendix, at the end of the radiology section, gives a list of pathologic conditions and their characteristic radiographic appearances that is useful for viva-voce examinations.

The specialty of oral medicine and radiology is a vast field that cannot be captured or presented in one book without adopting a perspective and making certain compromises in the presentation of the content. In an effort to present this clinical manual, a conscious decision was made to lean in favour of keeping the content and presentation in-line with a manual. The most pertinent and relevant information has been simplified and presented.

We hope that this manual will help students of dentistry

Ravikiran Ongole
Praveen BN

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We wish to express our sincere gratitude to our esteemed teachers and guides Dr Keerthilatha M Pai, Dr PK Dayal and Dr NS Yadav who have taught us the fundamentals of Oral Medicine and Radiology.

We are greatly indebted to Dr Surendra Shetty and Dr Prakash Tandur for their invaluable support and encouragement rendered during the period of preparing this manual.

Our sincere thanks are due to Dr Balaji Rao for his constant support, guidance and suggestions at every stage in the preparation of this book.

We are grateful to our students who were the inspiring force for making this manual a reality.

We appreciate the support and encouragement received from the ever enthusiastic publishing team of Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.

We are thankful to Dr Chaitra G Rao, Dr Chandu Nadig, Dr Divya Reddy, Dr Jyotsna, Dr Kavitha, Dr Kaushal Dhawan, Dr Iti Negi, Dr Sandeep Kasana, Dr Chiradeep Halder and Dr Gurminder Kaur and for the help rendered during the preparation of the manual.

Our heartfelt thanks to Dr Joanna (Ravikiran's wife) for painstakingly reviewing the proof and for the constructive criticism and suggestions that helped in the preparation of the manual.

Our deepest appreciation and gratitude to our patients, some of who were terminally ill, for enduring pain and discomfort in the hope of relief and cure. We hope that this clinical manual will in some small way alleviate their suffering.

Above all our gratitude to our families for their affection, unconditional support and encouragement.

Ravikiran Ongole
Praveen BN

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Section One

Oral Medicine



Case History

The purpose of recording the patient's history and conducting a clinical examination is to arrive at a logical diagnosis to the patient's chief complaint and to institute a suitable treatment plan. The clinical case history record is a permanent document containing the findings of various examinations, the interpretation of the data gathered, the treatment provided and the nature of complications that were encountered. It is a personal record and a legal document.

Case history is a planned, professional conversation between the patient and the clinician in which the patient reveals his/her symptoms, fears, or feelings to the clinician so that the nature of the real or suspected illness and mental attitude to it may be determined.

The path to managing the problem for which the patient seeks consultation can be roughly divided into four steps

1. Recording the patient's history
2. General physical examination and local examination
3. Establishing a diagnosis
4. Formulating a suitable treatment plan

RECORDING THE PATIENT'S HISTORY

The primary objective of the "history taking" is to identify all relevant information. Occasionally the patient might describe non-contributory incidents in the history. It is the skilled oral physician who can provide a certain direction to the answers provided by the patient by using different types of questions.

Diagnostic Interview

Various types of questions that can be posed to a patient during the diagnostic interview can be broadly classified as *open ended questions*, *closed ended questions* and *leading questions*.

Open ended questions are usually asked at the beginning of the history taking. These questions encourage the patient to convey his/her problem.

For example: Why have you come to the hospital?

Closed ended questions help the clinician to obtain specific information. These questions usually limit the answer of the patient to a single sentence or just to a 'Yes' or 'No'.

For example: Do your gums bleed when you brush your teeth?

Leading questions generally have an answer within the question. They help in bringing out a response from unresponsive patient's and winning the confidence of suspecting patient's.

However, leading questions when posed and if found incorrect by the patient, the patient may lose confidence in the oral physician.

For example: If there is a scar on the lower third of the face. A clinician might ask, "I presume you had an accident couple of years ago?"

GENERAL PHYSICAL EXAMINATION AND LOCAL EXAMINATION

Once the historical database is gathered, objective signs are recorded by a systematic examination.

Assessing the general health of the patient forms an important step in arriving at a diagnosis and formulating a treatment plan. The general health status of the patient can help the oral physician to understand the nature of the patient's present illness. The extraoral examination is mainly focused at examining the head and neck region and making a note of all gross abnormalities. Intraoral examination specifically deals with examining structures within the oral cavity in detail.

Clinical Steps of Examination

The local examination both intraoral and extraoral are carried out using the *four steps of examination: Inspection, Palpation, Percussion and Auscultation*. *Probing* is considered another effective examination technique as a part of palpatory examination.

Inspection

A passive visualization of the lesion is referred to as Inspection. The oral physician can carry out inspection when the patient is resting on the dental chair. However a more active process of inspection can be carried out by asking the patient to open the mouth, protrude the tongue, clearing all the excess saliva, etc. These steps may help in providing better visual access so that detailed observations can be carried out. An intraoral mirror can be used effectively to retract the cheeks, lips and tongue and can even be used for indirect visualization of the structures in maxillary arch. Examination of the contents of maxillary sinus using transillumination is also considered a part of inspectory examination.

Palpation

Palpation (examination by touch) helps the oral physician to evaluate deep structures and the anatomic relationships that are not visually apparent. The characteristics of the lesion such as tenderness, consistency, scrapability, fixity, etc, can be evaluated with palpation.

Methods of Palpation

Based on the anatomic location that is palpated several techniques of palpation can be employed.

Bilateral palpation: In order to appreciate differences in symmetrical structures, bilateral palpation can be employed. Subtle abnormalities can be detected using this technique. (For example: palpation of parotid gland, zygomatic arch) (Figure 1.1)



Figure 1.1: Bilateral palpation

Bidigital palpation: Two fingers are used to manipulate tissues in order to evaluate masses within the tissue. This technique of examination is generally used for thinner structures. (examination of the lesions within the lip) (Figure 1.2).

Bimanual palpation: Palms of both the hands are used for bimanual palpation. One hand is used to support the structures from the outside, and the other hand is used to manipulate tissue within the oral cavity. This technique helps to appreciate deep lying structures. (Structures of the floor of the mouth are best evaluated using bimanual palpation) (Figure 1.3).

Probing

Most of the intraoral examination is carried out by probing. Probing helps to detect carious lesions, estimate the amount of periodontal destruction and to trace sinus tracts. Probing is carried out using straight probes, explorers, periodontal probes and in certain cases gutta-percha points can be used. (To trace sinus tracts radiographically) (Figure 1.4).

Percussion

Percussion can be used in order to clinically assess if the tooth in question has an acute periapical infection. The back end of a mirror handle can be used for percussion.



Figure 1.2: Bidigital palpation



Figure 1.3: Bimanual palpation



Figure 1.4: Guttapercha point used for tracing sinus tract

The incisal or occlusal surface of the tooth is gently tapped (it must be ensured that only the weight of the instrument falls on the tooth) with the back end of the mirror handle kept parallel to the long axis of the tooth. If the patient “winces” then the tooth is said to be tender on vertical percussion and signifies an acute periapical infection (Figure 1.5).

Alternatively the handle of the mouth mirror is placed between the occlusal surfaces of the suspected teeth and the patient is instructed to bite firmly over the handle of the instrument (Figure 1.6). The tooth that is tender on horizontal percussion (tapping the tooth gently with the handle of the instrument kept perpendicular to the long axis of the tooth) signifies pathology of the lateral periodontal ligament (periodontal abscess) (Figure 1.7).

Percussion can also be used to identify teeth that are ankylosed (fused) to the underlying bone. Normal teeth when



Figure 1.5: Vertical percussion



Figure 1.6: Biting on handle of instrument

percussed produce a dull note, whereas ankylosed teeth produce a sharper resonant note.

Auscultation

In a dental setting auscultation is used to study the movements of the temporomandibular joint. Bell-End of the stethoscope is used to assess the joint sounds (Figure 1.8).

ESTABLISHING A DIAGNOSIS

Arriving at a diagnosis involves a systematic correlation of the basic data collected by the oral physician. This basic data comes from the history obtained from the patient, thorough general physical assessment, detailed extraoral and intraoral examination and then correlating them with the investigative reports.



Figure 1.7: Horizontal percussion



Figure 1.8: Auscultation of TMJ

Based on the history and examination the clinician arrives at a *tentative diagnosis/provisional diagnosis/clinical impression or a working diagnosis*. This clinical diagnosis is further confirmed with the investigative reports. The diagnosis that is arrived at after investigations is referred to as final diagnosis. The treatment is planned based on the final diagnosis.

FORMULATING A TREATMENT PLAN

Treatment planning forms the final aspect of the diagnostic process. In order to plan an effective treatment modality for the patient, the clinician should take into account the pertinent facts from the history elicited from the patient and important clinical findings obtained from the general physical examination and the local examination and correlate those facts with the investigations. The general health of the patient should also be taken into consideration before an effective treatment is planned.

While formulating treatment options for patient's with an underlying systemic disease, care needs to be taken to evaluate the effects of the dental treatment on the underlying disease. The clinician can then refer the patient to his/her physician with a referral letter, describing the dental treatment that is planned. The consultant can be asked to comment on the precautions that need to be taken during the dental procedure. An effective treatment plan can be broadly grouped into six continuous phases: *Emergency Phase, Surgical Phase, Prophylactic Phase, Restorative Phase, Corrective Phase and Recall and Review*.

GENERAL GUIDELINES FOR EXAMINING PATIENT'S IN A DENTAL SETTING

1. Greet the patient and always check if you have the case sheet of the right patient, this can be ensured by cross checking the name of the patient and his/her age and address.

2. It is advisable to have an attendant along with the patient, however all communication needs to be done with the patient (exceptions are in child patient's, mentally challenged patient's, and patient's with hearing disabilities)
3. Position the dental chair so that the patient is comfortably seated (special care needs to be taken in pregnant women and patient's with spinal disorders)
4. The oral physician should ideally be seated to the right of the patient and facing the patient. The ideal position would be a 10 o' clock or 11 o' clock position (Figure 1.9).
5. Maintain a warm and dignified atmosphere.
6. Exhibit empathic interest in the patient's systemic and oral health.
7. Maintain eye contact and exhibit controlled facial expressions
8. Promote the ability to view the patient's problem from his/her viewpoint.
9. Listen attentively to the patient; avoid being judgemental, impatient or unsympathetic to the patient's problem.
10. Use simple vocabulary while conversing with the patient; avoid using slang and medical jargon as far as possible.
11. Use an interpreter when a language barrier exists.
12. Examine the patient under sufficient unobstructed light.
13. Follow universal precautions of care: use gloves and mouth masks. Always use clean sterile instruments (Figure 1.10).
14. Drape the patient and avoid placing instruments/instrument tray over the patient's chest.
15. Avoid resting arms or hands over the patient's shoulder, always maintain a comfortable distance from the patient.
16. Ensure that diagnosis of a disease should always be revealed to the patient, and with only the patient's consent the patient's attender should be informed (exceptions are child patient's, mentally challenged patient's, and patient's with hearing disabilities)



Figure 1.9: Ideal seating position



Figure 1.10: Instruments

CASE HISTORY PROFORMA

Identifying data

Out Patient (O.P.) number

Name

Age

Sex

Date

Occupation

Address

CHIEF COMPLAINT

HISTORY OF PRESENT ILLNESS

(mode of onset, duration, progress, aggravating/relieving factors, details of treatment undertaken for the same and associated symptoms)

PAST DENTAL HISTORY

PAST MEDICAL HISTORY

Ask questions related to

a) CVS b) Respiratory c) GIT d) CNS e) Dermatology f) STD & Urinogenital g) HIV related symptoms h) Medication side effects, Allergies etc. i) Psychiatry j) ENT related problems k) any other

PERSONAL HISTORY

- a. Diet
- b. Marital Status
- c. Habits
 - i. Tobacco
 - ii. Alcohol
 - iii. Drugs
 - iv. Oral Habits
- d. Oral Hygiene Methods

FAMILY HISTORY

GENERAL PHYSICAL EXAMINATION

I. General

- a. Gait Height
- b. Build Weight

Contd....



Contd....

- c. Nourishment
- d. Posture
- e. Skin
- f. Hair
- g. Nails
- h. Vital Signs
 - Temperature Respiration
 - Pulse Blood Pressure
- i. Sclera
- j. Conjunctiva
- k. Pallor
- l. Cyanosis
- m. Clubbing
- n. Oedema

II. Extraoral Examination (Head and Neck)

- a. Face
- b. Skin
- c. Nose
- d. Eyes
- e. TMJ
- f. Salivary Glands
- g. Lymph Nodes (Head and Neck)
- h. Others

INTRAORAL EXAMINATION

I. Hard Tissue Examination

- a. Teeth Present
- b. Missing Teeth
- c. Dental Caries
- d. Dental Caries with Pulpal Involvement
- e. Root Stumps
- f. Wasting diseases
- g. Mobility
- h. Occlusion
- i. Deposits
- j. Fractured Teeth
- k. Others (hypoplasia, supernumerary teeth, malposition, etc.)

II. Soft Tissue Examination

- a. Gingiva
- b. Periodontal Pockets
- c. Buccal Mucosa
- d. Floor of the Mouth
- e. Vestibule
- f. Tongue
- g. Lips
- h. Palate

Contd....

Contd....

- i. Tonsils
- j. Oropharynx

EXAMINATION OF THE LESION

Extraoral

- a. Inspection
- b. Palpation
- c. Auscultation

Intraoral

- a. Inspection
- b. Palpation
- c. Percussion

VITALITY TESTS

PROVISIONAL DIAGNOSIS

DIFFERENTIAL DIAGNOSIS

INVESTIGATIONS

FINAL DIAGNOSIS

TREATMENT PLAN

PROGNOSIS AND RECALL

CASE ANALYSIS

Identification Data

Out patient Number

Every patient who is examined for the first time is given an out patient (OP) number. It helps in identification of the patient and keeping track of the treatment carried out in other specialties. Out patient number is an important consideration in medicolegal cases and retrieval of the patient's case sheet is made simpler during his subsequent visits to the oral physician.

Name

Recording the name of the patient helps in identifying the patient. Also referring to the patient by name helps in improving the patient-physician relationship.

Age

There are certain disorders that are age related. Recording the age of the patient will help the clinician to some extent in the process of formulating a clinical diagnosis. Age is considered as one of the important parameters while formulating a clinical diagnosis. Another purpose of recording age is for calculating a suitable dosage of the required drug.

For example:

1. At Birth: Congenital cleft lip and palate
2. 1st –2nd decades: Cherubism, fibro osseous lesions
3. Middle aged: Ameloblastoma, oral cancers
4. Old age: Degenerative osteoarthritis of the TMJ, oral cancers

Sex

In a female patient additional questions are to be included in the diagnostic questionnaire, such as history of pregnancy, nursing, use of oral contraceptive pills and menstruation history. Certain diseases are common in either of the sexes.

For example:

Females: Lichen planus, Temporomandibular disorders

Males: Hemophilia, Oral cancer

Address

The complete postal address and phone number if any should be recorded. It helps in communicating with the patient for future consultations and conveying any information regarding appointments. Address also gives the physician an insight into the diseases prevalent in that geographical area. It may also give an idea of the socioeconomic status of the patient.

For example: Dental fluorosis is common in certain parts of Andhra Pradesh, Karnataka and Rajasthan.

Occupation

The occupation of the patient gives an insight into the working environment of the patient and the occupational hazards that the patient is prone to. Occupation of the patient also gives an insight to his/her socio-economic status.

Tailors and beauticians usually have notching of the incisal edges of upper teeth, as they tend to hold pins and sewing thread with their teeth. Individuals working in acidic environments tend to have erosion of teeth (Figure 1.11).

Orofacial problems seen in musicians may range from soft tissue trauma to herpes labialis, dry mouth, severe proclination of teeth and temporomandibular joint pain. Fiddler's neck is a common feature in violin players. The area on the left side of the neck, where the violin rests, may reveal chronic dermatitis and severe pain.

Musculoskeletal disorders because of poor posture, contact dermatitis resulting from latex allergy and biomaterials, exposure to contaminated blood leading to Hepatitis and HIV and radiation hazards to unprotected personnel working in the radiology department are some of the occupational hazards to dental practitioners.

Chief Complaint

It is the description of the problem for which the patient seeks treatment.



Figure 1.11: Notching of incisors

It should be recorded in the patient's own words and should not be recorded in medical terminology unless told by the patient in those terms.

For example:

Do not use the terms anterior, maxillary, etc, use front, upper. When multiple complaints are reported, they have to be noted down in a chronological order.

For example:

Patient complains of pain in the right upper back tooth for the past 1 week and swelling on the right side of the face for the past 3 days.

History of Present Illness

It is a detailed description of the chief complaint.

The dentist should ask specific questions in order to elicit a detailed description of the patient's illness.

1. When was the problem first noticed? (duration in days, weeks, months, years)
2. Mode of onset (sudden, gradual)
3. Aggravating factors
4. Relieving factors
5. Associated symptoms (fever, disturbed sleep, difficulty in eating, drinking, etc.)
6. Did the patient consult any other physician? (details of medication, investigations)

For example: If the chief complaint of the patient is about pain in the lower right back tooth, then the history of the present illness (pain) should be recorded as described below.

Patient complains of pain in the lower right back tooth for the past one week. It was sudden in onset. The pain is localized and throbbing in nature. Patient reports that the severity of pain increases on consuming food and relieves on taking medication, the nature of medication taken is not known. Patient reports of disturbed sleep. Patient consulted a dental practitioner and was advised removal of the offending tooth.

Past Dental History

Previous history of oral surgical procedures, restorative treatment, periodontal treatment, and orthodontic corrections should be noted.

More importantly gathering information about the procedures being eventful or uneventful is crucial. Ask specific questions with regards to the procedure, which might influence dental treatment

1. Was the extraction complicated?
 - i. Were you allergic to the local anesthetic? (skin rashes, difficulty in breathing, perspiration)
 - ii. Did you have continuous bleeding after the extraction?
 - iii. Did the extraction wound take a long time to heal?
 - iv. Did you have seizures, syncope, etc, before, during or after the procedure?

If the patient reports of an uncomplicated dental procedure, then the past dental history can be recorded as follows:

H/O an uneventful removal of the lower right back tooth 3 years back.

H/O undergoing correction of malaligned teeth 5 years back

In the event that the patient's previous dental treatment was eventful, the history can be recorded as below:

H/O of an eventful removal of the lower right back tooth 3 years back. Patient reports of an epileptic attack during the procedure.

Past Medical History

It is a description of significant or serious illnesses that the patient has had as a child or as an adult.

The information recorded in the past medical history helps the oral physician in assessing the overall health status of the patient. This information will help the dentist to refer the patient to a general physician for a consultation requesting for a work up on the suspected systemic illness of the patient. Since, dental treatment may alleviate or precipitate an existing systemic condition.

A note of all significant illnesses is made which might influence the dental treatment.

1. Do you suffer from any medical problem (Cardiac, Respiratory, Genitourinary, Nervous, Gastrointestinal, Endocrinal or Psychiatric disorders)? If so, are you on regular medication for the same?

In patient's who are not aware of their system status the following list of symptoms can be asked

Cardiovascular system: Chest pain, palpitations, dyspnoea

Respiratory system: wheezing, chest pain, cough, and haemoptysis.

Nervous System: Syncope, seizures, in-coordinate movements.

Gastrointestinal system: Nausea, dysphagia, change in the appetite, hematemesis, indigestion, constipation, diarrhea and vomiting.

Genitourinary system: Increased frequency of urination, nocturia, and haematuria.

Endocrinal system: Polyuria, Polyphagia, Polydypsia, intolerance to heat and cold, pigmentations, weight loss or gain.

Psychiatric system: mood swings, emotional disturbances.

2. Were you ever hospitalized? If yes, a detailed description of the illness for which you were hospitalized.
3. History of surgeries that required hospitalization, blood transfusions.
4. Are you allergic to any kind of food or medications? If so, the nature of the allergy
5. Are you pregnant (mention the trimester), a nursing mother, on oral contraceptives?

Personal History

Questions pertaining to the diet, oral hygiene methods, marital status and habits should be asked.

Diet: can be recorded as vegetarian diet or mixed diet. Excessive use of sticky food and refined sugar should be specifically asked.

Oral Hygiene methods: The following questions are asked.

- i. Do you use your finger, toothbrush, dental floss or twigs for cleaning teeth?
- ii. Do you use tooth powder, paste, or any other material to clean teeth?
- iii. How many times in a day do you clean your teeth?
- iv. Brushing strokes: horizontal, vertical, circular

Marital status: mention whether the patient is married or unmarried.

Habits: ask for specific habits related to the use of tobacco, alcohol, drug abuse and oral habits like thumb sucking, clenching teeth, tongue thrusting, mouth breathing, etc.

Tobacco

Form of tobacco used (smoke, snuff, chewable)

Mention the number of times used per day and for how many years has he seen using tobacco.

Where do you place the quid in the chewable form of tobacco? Do you spit or swallow tobacco?

(Cigarette smoking can be quantified as pack years = number of packs of cigarette smoked in one day multiplied by the number of years the patient has been smoking)

Alcohol

Quantity and frequency of consumption.

Do you consume alcohol along with use of tobacco?

Since how many years have you been consuming alcohol?

Family History

Patient is asked about the health of other members of his/her family. Specific questions related to genetic disorders, disease that are hereditary and conditions that are generally found in most members of the family living in an area endemic to a condition are specifically asked. (Diabetes, hypertension, bleeding disorders, fluorosis, etc.)

For example the family history can be recorded as below:

1. The patient's family consists of the patient's mother, wife/husband and two children who are said to be apparently healthy.

Or

2. The patient's family consists of the patient's mother who is a diabetic, wife/husband and two children who are said to have yellowish brown discoloration of teeth.

Certain conditions which are thought to be "familial diseases" are: Diabetes mellitus, hypertensive vascular disease, rheumatoid arthritis, osteoarthritis, epilepsy, psychosis, migraine, bleeding diathesis, cancer, hereditary ectodermal dysplasia, Marfans syndrome and Ehlers Danlos syndrome.

General Physical Examination

Gait (Manner of Walking)

The gait of the patient can be evaluated as the patient enters the dental office.

Many of the gait abnormalities relate to neuromuscular disabilities the cause of which may be as varied as traumatic injuries to degenerative muscular disease. Certain forms of gait are hemiplegic gait, ataxic gait, Parkinsonian gait, scissors gait, foot drop gait and equine gait.

Height and Weight

They indicate the development and growth of an individual. To evaluate whether the weight is proportional to the height of an individual Quetelet body mass index is used. The normal range of the index for men is 10-25 and 18-24 in women (Figures 1.12A and B).

$$\text{Quetelet body mass index (BMI)} = \frac{\text{Weight in kilograms}}{(\text{Height in meters})^2}$$

Build

The build of the patient can be described as poorly built, moderately built or well built. It can be roughly assessed based on the muscle mass and skeletal frame of the individual. An individuals build can also be grouped into: **asthenic**, **sthenic**, **hypersthenic** and **pyknic** builds.



Figures 1.12A and B: Weighing scale and height scale

Asthenic individuals appear lean and underweight as they have a low bone and muscle mass.

Sthenic individuals are athletic in appearance. They have a well proportioned muscle and bone mass.

Hypersthenic persons have thick muscular and heavy bone structures.

Pyknic individuals appear heavy and rounded as they have an enormous amount of body fat as compared to the amount of bone and muscle mass.

Cachexia maybe defined as an abnormally low tissue mass resulting from malnutrition or chronic debilitation.

Nourishment

The nourishment of an individual can be assessed by evaluating the presence and distribution of body fat and muscle bulk. It can be recorded as poorly nourished/malnourished, moderately nourished and well nourished.

Posture

Some patient's may not assume a regular sitting or standing posture. Generally these postures indicate pain that can be caused by a regular posture or a limitation to assume a regular posture. Disabilities from a past injury and arthritis are the most common causes for assuming an abnormal posture. A slumping posture is assumed by patient's with cardiopulmonary disease in order to facilitate easy breathing.

Skin

The skin is examined for hydration, pallor, pigmentations, cyanosis and skin eruptions.

Hydration: when the skin is pinched up using the index finger and thumb, if a ridge is left behind then the skin is said to be dehydrated (Figure 1.13).

Generalized pallor of the skin may be seen in severe Anemia; however, pallor is best appreciated over the mucosal surfaces like in the oral cavity and conjunctiva. Generalized yellowishness of the skin is seen in jaundice. In cyanosis, skin and mucous membranes acquire a bluish hue.

Hair

Human hair undergoes a periodic cycle of growth and shedding. Generally 90% of the hair follicles are in the growing phase



Figure 1.13: Evaluation of hydration

(anagen) and 10% are in the resting phase (telogen). During the resting phase hair is shed.

A change in this ratio may result in an increased rate of hair loss. The term alopecia is used to refer to loss of hair. A note should be made whether the patient has partial or total alopecia over the scalp and eye brows.

Partial alopecia is seen in xeroderma pigmentosum and hereditary ectodermal dysplasia. Total alopecia can arise from X-ray irradiation, chemotherapy, scalp ringworm and herpes zoster infection. Severe anemia and hypothyroidism can cause diffuse hair loss in women.

Hypertrichosis refers to an excessive growth of terminal hair. It should not be used interchangeably with hirsutism, that refers to growth of terminal hair in a female patient in a male pattern.

Hirsutism is commonly seen in Asians. It is commonly seen after menopause and frequently follows a familial pattern.

Nails

Examination of the nails and nail bed form an important part of general physical examination. Variety of systemic conditions and local causes produce nail abnormalities.

Epidermolysis bullosa and Lichen planus may cause longitudinal ridging of nails and pterigium (overgrowth of cuticle on the nail plate). Thick nails (Pachyonychia) may be seen in psoriasis. Nail beds may reveal splinter hemorrhages in trauma, bacterial endocarditis and psoriasis. Koilonychia (spoon shaped, concave) nails are seen in iron deficiency anemia. Antimalarials and antibiotics may discolor the nail.

Vital Signs

The vital signs are pulse rate, respiratory rate, body temperature and blood pressure. These parameters are termed vital signs because they provide immediate evidence of the patient's essential physiologic functions.

Pulse rate: Examination of pulse gives an idea of the heart rate, cardiac rhythm, cardiac output and peripheral circulation.

The radial, brachial, femoral and carotid pulse are generally examined because of their accessibility owing to their locations superficial to bone and dense muscle. In a dental setting the radial, brachial and carotid pulse are easily examined.

Anatomic Locations of the Pulse

Radial pulse: located on the ventral aspect of the wrist, proximal to the radial head between the flexor carpi radialis and brachioradialis tendons.

Brachial pulse: located medial to the biceps tendon in the antecubital fossa.

Carotid pulse: It is located medial to the sternocleidomastoid muscle, inferior and medial to the angle of the mandible.



Figure 1.14

Examination of the pulse (Figure 1.14): Pulse is examined by placing the tips of the index and middle fingers evenly over the course of the artery. Excessive application of force might occlude the artery thereby obscuring the pulse. Pulse is felt for 60 seconds and expressed as beats per minute. The normal pulse rate for an adult is about 60 to 80 beats per minute. A pulse rate above 100 beats per minute is referred to as Tachycardia and below 60 beats per minute is referred to as Bradycardia. Tachycardia is generally seen during periods of emotional stress, after strenuous physical exercise, high fever, anemia, hyperthyroidism and congestive cardiac failure.

Bradycardia or a low pulse rate is seen in hypothyroidism, hypoadrenalism, convalescence, and secondary to medications such as digitalis and quinidine. The maximum accepted safe pulse rate in an individual after physical exercise is 200 beats per minute minus the age of the patient in years.

Temperature: In a dental office the oral body temperature can be readily recorded. Make sure that the patient has not smoked, or consumed hot or cold food at least ten minutes prior to recording the oral temperature. Ensure that the thermometer is thoroughly rinsed in an antiseptic solution and mercury is shaken down before recording the temperature. The thermometer is best placed in the lingual sulcus beneath the tongue. Patient is advised to breathe through his nose and keep his lips closed around the body of the thermometer. The thermometer is taken out roughly after a minute and the temperature is noted down. The normal body temperature in an adult is about 98.6° Fahrenheit or 37°Centigrade.

Hypothermia less than 35°C or less than 95°F

Febrile greater than 37.2°C or greater than 99°F

Subnormal less than 36.6°C or less than 98°F

Hyperpyrexia greater than 41.6°C or greater than 107°F

Conversion of Fahrenheit to Celsius and vice versa

1. Celsius to Fahrenheit: $^{\circ}\text{F} = (^{\circ}\text{C} \times 9/5) + 32$
2. Fahrenheit to Celsius: $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 5/9$

The rectal temperature is about 0.5°C higher than the oral temperature and the axillary temperature is approximately 0.2°C lower than the oral temperature.

Respiratory rate: One respiratory cycle includes one full inspiration and expiration. A rate of 12 to 20 breaths per minute is considered normal for a healthy adult. Rapid breathing is referred to as Tachypnea and is seen commonly in pyrexia.

Blood pressure: The systolic and diastolic blood pressure is evaluated using a Sphygmomanometer.

Examination: (Figure 1.15) The patient is seated and his right arm is placed on a table so that the elbow is supported and the forearm is at the level of heart. The cuff is centered over the brachial artery. The pressure cuff is wrapped snugly around the upper arm with its lower border roughly one inch above the elbow crease in the antecubital fossa. The patient's radial pulse is palpated and the cuff is inflated up to about 20 to 30 mm Hg above the point at which the pulse is no longer palpable. The cuff is now deflated very gradually until the first pulse is palpable. This is recorded as the systolic pressure. In this technique the diastolic pressure cannot be evaluated.



Figure 1.15: Evaluation of blood pressure

The cuff is deflated and removed from the patient's arm, and then replaced and reinflated to the same maximum pressure. Placing the diaphragm of the stethoscope over the brachial artery just distal to the elbow crease, the clinician deflates the cuff about 2-3 mm Hg per second until the first sound appears. This first sound is recorded as the systolic pressure.

The pressure in the cuff is further lowered until the sounds disappear. This point is the diastolic pressure. However if the cuff is applied too loosely, if it is not completely deflated before applying, or if it is too small for the patient's arm size, the pressure readings will be faulty.

Hypertension is defined as having a Systolic Blood Pressure of greater than or equal to 140 mm Hg or a Diastolic Blood Pressure greater than or equal to 90 mm Hg.

Classification of Blood Pressure (National High Blood Pressure Education Program, NIH publication)

	<i>Systolic Blood Pressure (mm Hg)</i>	<i>Diastolic Blood Pressure (mm Hg)</i>
Optimal	Less than 120	Less than 80
Normal	Less than 130	Less than 85
High Normal	130-139	85-89

HYPERTENSION

<i>Staging</i>	<i>Systolic blood pressure (mm Hg)</i>	<i>Diastolic blood pressure (mm Hg)</i>
Stage 1	140-159	90-99
Stage 2	160-179	100-109
Stage 3	Greater than or equal to 180	Greater than or equal to 110

Sclera

Examine the color of the sclera. In jaundice the sclera appears yellowish and blue colored sclera is seen in Osteogenesis imperfecta, Osteoporosis, fetal rickets, Marfan's syndrome and Ehlers-Danlos syndrome. However blue colored sclera can also be a normal finding in certain individuals.

Conjunctiva

Conjunctiva is generally pale in anemia, yellow in jaundice and red in conjunctivitis.

Bulbar conjunctiva (lines the eyeball) and Palpebral conjunctiva (lines the upper and lower eye lids) should be examined.

Palpebral conjunctiva of both the lower and upper eyelids should be evaluated. To examine the palpebral conjunctiva of the lower lid, it should be pulled down and the patient is asked to look up. To examine the palpebral conjunctiva of the upper eyelid, the upper lid is everted and patient is asked to look downwards. (Figure 1.16)

**Figure 1.16**

Pallor

Pallor of the skin depends on the thickness of the skin and the amount and quality of blood in the capillaries. The color of the oral mucous membrane and the mucosa of the conjunctivae give a better indication of the pallor.

Pale skin or mucous membranes can have various causes. Shock and hemorrhage can cause a transient phase of pallor however anemia can produce a persistent pallor.

Cyanosis

Cyanosis is the bluish discoloration of the skin and mucous membranes as a result of reduced hemoglobin level in blood. There are two types of cyanosis, central and peripheral

Central cyanosis : Imperfect oxygenation of blood because of cardiac or lung disease

Features : generalized cyanosis, extremities are warm to touch, tongue is the best site to check for cyanosis

Peripheral cyanosis : excessive reduction of oxyhemoglobin in the capillaries when the flow of blood is slowed (exposure to cold, venous obstruction or in heart failure).

Features: Cyanosed extremities are cold to touch, tongue is unaffected.

Clubbing

Clubbing is characterized by thickening of the nail bed; obliteration of the angle between nail base and adjacent skin of the finger and the nail becomes convex, losing its longitudinal ridges. The probable cause for clubbing has been thought to be because of hypervascularity and opening of anastomotic channels in the nail bed.

Schamroth's window test is used to check for clubbing. When the nails of two index fingers are placed in apposition, there is a lozenge shaped gap, however in clubbing there is a reduction in this gap. Conditions where clubbing is seen are

Crohn's disease, lung abscess, ulcerative colitis, bronchiectasis, infective endocarditis (Figures 1.17A and B).

Oedema

Oedema is a result of accumulation of excess fluid within the subcutaneous tissues. Oedema may also be a feature of cutaneous or subcutaneous inflammatory reaction. Early morning oedema of the face may be seen in acute nephritis, dependent oedema may be seen in congestive heart failure. Oedema may be recognized by the presence of glossy skin surface over the swollen site which pits on finger pressure. Pitting oedema can be readily demonstrated over the ankles and dorsal surface of the feet.



A



B

Figures 1.17A and B

Extraoral Examination (Head and Neck)

Face

Gross asymmetries of the face are noted. In the absence of any abnormality, the statement "The face is apparently symmetrical" can be made. Diffuse swellings, traumatic injuries, congenital deformities can contribute to asymmetry of the face (Figure 1.18).

Skin

Presence of areas of altered pigmentation, scars, ulcers, sinuses, and lacerations are noted (Figure 1.19).

**Figure 1.18****Figure 1.19**

Nose

In a dental setting the external surface of the nose and the nares can be readily visualized. Deflected nasal septum can also be examined. A saddle nose or depression of the bridge of the nose is seen in syphilis (Figure 1.20).

**Figure 1.20**

Eyes

Congenital abnormalities can cause Hypertelorism (increased spacing between both the eyes). Check for presence of pallor, icterus, and conjunctivitis. Exophthalmoses (protrusion of the eye ball) may be a sign of hyperthyroidism (Figure 1.21).

Temporomandibular Joint

Look for gross deviation of the mandible; note any clinically evident masses over the TMJ. Palpate the joint, check for



Figure 1.21

mouth opening, comment on tenderness on palpation, clicks are to be recorded. Also note deviation of the mandible on mouth opening.

Salivary Glands

Examine the major salivary glands (parotid, submandibular and sublingual glands). Evaluate for enlargements, dryness of mouth and the quantity and character of the secretions (watery, purulent) from the respective orifices.

Lymph Nodes (Head and Neck)

Examine the lymph nodes of the head and neck region. Comment on the site, size, number, consistency, tenderness and fixity to the underlying structures.

INTRAORAL EXAMINATION

Hard Tissues

Teeth Present

Make a note of the total number of teeth present. Record the teeth present in FDI or Zigmond's Palmer system of

nomenclature of teeth notation. Specifically examine for presence of the third molars. If the third molars are partially covered by a pericoronal flap then they can be recorded as impacted teeth.

ZIGMONDY PALMER SYSTEM

DECIDUOUS DENTITION

E	D	C	B	A	A	B	C	D	E
E	D	C	B	A	A	B	C	D	E

PERMANENT DENTITION

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

FDI (FEDERATION DENTAIRE INTERNATIONALE) SYSTEM

DECIDUOUS DENTITION

55	54	53	52	51	61	62	63	64	65
85	84	83	82	81	71	72	73	74	75

PERMANENT DENTITION

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	43	42	41	31	32	33	34	35	36	37	38	

ADA (AMERICAN DENTAL ASSOCIATION) SYSTEM OR UNIVERSAL SYSTEM

In this system of nomenclature permanent teeth are numbered from 1 to 32. Each tooth in the arch is given a single number. The numbering of teeth begins with the upper right third molar and ends with the lower right third molar (In a clock wise direction).

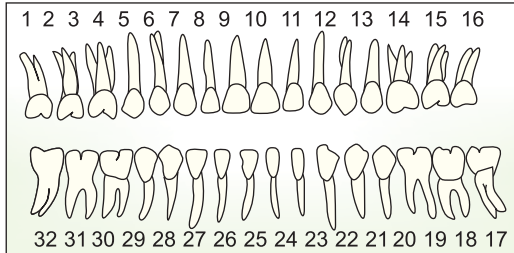
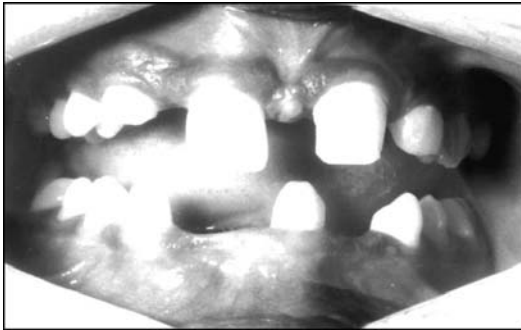
Deciduous teeth are named with alphabets (A to T) starting from the upper right second molar and ending with the lower right second molar (In a clockwise direction) (Figure 1.22).

Missing Teeth

Make a note of the teeth that are absent. (Ask the patient the reason for loss of teeth; exfoliated as a result of mobility or trauma; extracted following decay or trauma; congenitally missing teeth).

Congenitally missing teeth: (Figure 1.23)

A total lack of tooth development is referred to as *Anodontia*. Lack of development of one or more teeth is referred to as *Hypodontia* and lack of development of six or more teeth is termed as *Oligodontia*. Congenitally missing teeth should be confirmed radiographically.

**Figure 1.22****Figure 1.23**

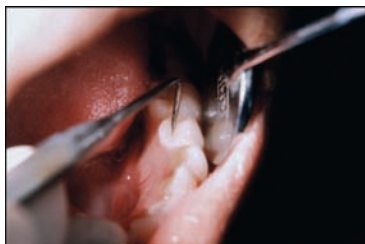
Edentulous arches

In edentulous patients examine the alveolar ridge. Comment on the shape (U shaped/V shaped); well formed or flabby ridges. Examine for the presence of bony spicules, and tori. Palpate to evaluate for tender areas on the alveolar ridge. Comment on the palatal vault (shallow, deep).

Dental Caries

Record all the teeth that are carious. Describe the site of decay (occlusal, proximal, buccal, lingual cervical, root surface).

The surfaces of teeth must be examined for chalky white or dark discoloration or cavitation. These are signs of initial decay of teeth. However, a “catch” experienced during probing



A: To evaluate for catch



B: Correct method for detecting proximal caries



C: Incorrect method for detecting proximal caries

Figures 1.24A to C

the surface of the tooth is a definitive evidence of decay (Figures 1.24A to C). Proximal caries are generally difficult to detect. However, positioning the explorer tip interproximally and directing pressure pulpally can help detect proximal caries. Dental floss can also be used to detect proximal caries. Fraying of the strands of the dental floss can indicate proximal caries. Radiographs are generally the best ways to identify proximal carious lesion (Figure 1.25).



Figure 1.25

Dental Caries with Pulpal Involvement

Make a note of all teeth, which are extensively decayed with a possible clinical suspicion of pulpal involvement. All such teeth are to be percussed and any tenderness elicited should be recorded.

Root Stumps

These are teeth with extensive carious lesions with barely or no crown structure evident clinically (Figure 1.26).



Figure 1.26

Wasting Diseases

Make a note of attrition, abrasion, erosion and abfraction. Patient may report of sensitivity on taking cold, hot food or may even complain of sensitivity when the probe is passed over the site of attrition, abrasion or erosion. Sometimes when the pulp is exposed the tooth may be tender on percussion resulting from extension of the infection to the periapex.

Attrition is defined as the physiologic wearing away of teeth as a result of tooth to tooth contact. It occurs on the occlusal and incisal surfaces of teeth (age related, habitual chewing of tobacco, clenching and bruxism).

Clinical examination will reveal wear facets and worn out occlusal surface of the tooth to reveal the underlying yellowish dentine and sometimes resulting in pulpal exposure (Figure 1.27).

Abrasion is defined as pathological wearing away of the tooth material through abnormal mechanical process. Clinically abrasions are seen as V-shaped or a wedge shaped ditches on the cervical margins of the tooth on the root surface. Generally teeth with abrasions have gingival recession exposing the root surface (Figure 1.28).

Causes: over zealous and faulty tooth brushing technique (generally right handed individuals have abrasive lesions on the left sided teeth and vice-versa), use of coarse and abrasive dentifrice.

Erosion is defined as loss of tooth material by a chemical process. Erosions are generally seen on the labial and buccal surfaces of teeth and they generally occur as scooped out areas on the enamel surface on the cervical third, they are shallow and broad (Figure 1.29).

Causes can be varied such as consumption of citric food (carbonated drinks, lime, tamarind), constant vomiting, gastro-oesophageal reflux (erosion seen on lingual surface of teeth), occupational hazards of working in acid batteries manufacturing



Figure 1.27



Figure 1.28



Figure 1.29

plants, etc. Erosion of teeth because of exposure to gastric secretions is termed Perimolysis.

Abfraction is the loss of tooth structure that results from repeated flexure of the tooth as a result of occlusal stresses. Constant occlusal loading can lead to disruption of the chemical bonds between the enamel crystals, which over a period of time may lead to cracking of the enamel. This cracked enamel can easily be chipped off by erosion or abrasion. It appears as wedge shaped defect on the cervical area of the tooth. It can be differentiated from erosion and abrasion as it generally affects a single tooth (adjacent teeth are normal). These defects the defects are V-shaped, deep and narrow and the lesions are generally subgingival.

Mobility

Generally local deposits and poor periodontal health cause mobility of teeth. In the absence of local factors and healthy periodontium; *ask for history of trauma, examine for traumatic occlusion, poorly fabricated partial dentures, underlying bone pathology and systemic conditions causing tooth mobility.* Grade the mobility of teeth. Evaluate whether the mobility is physiologic or pathological. Tooth mobility can be evaluated using the back ends of two slender mouth mirrors or the use of the back end of a mirror or probe and the clinicians finger (Figure 1.30).



Figure 1.30

Occlusion

Check for molar relationship, also comment on the overjet, overbite, mention areas of cross bites, open bite and crowding of teeth.

EVALUATING OCCLUSION IN PERMANENT DENTITION

Angle's system of classification can be used when evaluating molar relationship in permanent dentition. The *normal molar relationship* is when the *mesio-buccal cusp of the maxillary first permanent molar occludes in the buccal groove of the mandibular first permanent molar.*

Malocclusion can be diagnosed using Angle's classification of malocclusion. However this *classification cannot be used for deciduous dentition and when the first molars are missing.*

Angle's Class I malocclusion (Figure 1.31)

The mesio-buccal cusp of the maxillary first permanent molar occludes in the buccal groove of the mandibular first permanent molar, along with any of the dental irregularities such as crowding of teeth, spacing between teeth, rotated teeth, etc.

Class I Bimaxillary protrusion: Patient's exhibit a regular Class I molar relation but the dentition of the maxillary and mandibular arches are forwardly placed in relation to the facial profile.

Angle's Class II malocclusion: (Figure 1.32)

The disto-buccal cusp of the maxillary first molar occludes in the buccal groove of the mandibular first permanent molar.

Angle's Class II malocclusion is divided into two divisions

Angle's Class II Division 1: Class II molar relationship with proclined maxillary incisors with a resultant increase in overjet. Other features of this division are short, hypotonic upper lip and narrow upper arch.

Angle's Class II Division 2: Class II molar relationship with palatal inclination of maxillary central incisors and labially tipped maxillary lateral incisors overlapping the central incisors. Other features exhibited are deep anterior over bite and wide maxillary arch.

Angle's Class II Subdivision: When the patient exhibits class I molar relation on one side and Class II molar relationship on the other then, the malocclusion is referred to as Angle's Class II Subdivision.

Angle's Class III malocclusion: (Figure 1.33)

The mesio-buccal cusp of the maxillary first permanent molar occludes in the interdental space between the mandibular first and second molars.

Angle's Class III malocclusion is categorized into *True Class III and Pseudo Class III.*



Figure 1.31



Figure 1.32



Figure 1.33

True Class III malocclusion: It is a skeletal relationship caused by an excessively large mandible or smaller than normal maxilla or a combination of the above. The other features noticed in a True Class III are lingually inclined mandibular anteriors, edge to edge incisor relation or an anterior cross bite.

Pseudo Class III malocclusion: Pseudo Class III malocclusion is also referred to as *Habitual or Postural Class III malocclusion*. Like the name suggests, because of a functional disturbance the patient is habituated to position the mandible ahead of the maxilla. The functional disturbances could be because of premature loss of teeth or occlusal prematureties.

Class III Subdivision: Presence of Angle's Class I on one side and Class III on the other is referred to as Class III subdivision.

When the first permanent molars are missing then the Canine relationship is taken into consideration to evaluate the occlusion of the patient.

Canine Relationship (Figure 1.34 A to C)

Canine class I relationship (normal): The mesial incline of the upper permanent canine overlaps the distal incline of the lower canine.

Canine class II relationship: The upper permanent canine is placed forward. Distal incline of the upper canine contacts the mesial incline of the lower canine.

Canine class III relationship: The lower permanent canine is placed forward in relation to the upper canine and there is no overlap.

In individuals with missing permanent first molar and canines, the occlusion is referred to as mutilated.

Evaluating Occlusion in Deciduous Dentition (Figures 1.35 A to C)

The relationship between the distal surfaces of the maxillary and mandibular second deciduous molar is evaluated for categorizing the occlusion.

Flush Terminal Plane: The distal surfaces of the maxillary and mandibular second molar are in a straight plane (flush).

Mesial Step: The distal surface of the mandibular second molar is more mesial to that of the maxillary second molar.

Distal Step: The distal surface of the mandibular second molar is more distal to the maxillary second molar.

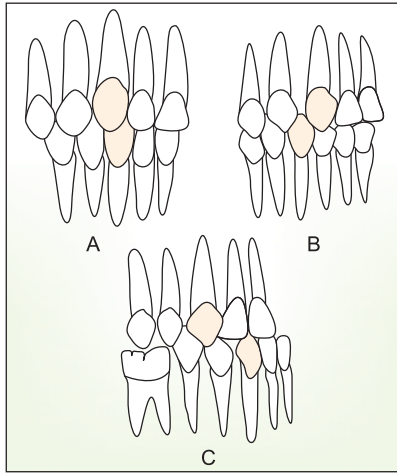
Deposits

Make a note of calculus and stains.

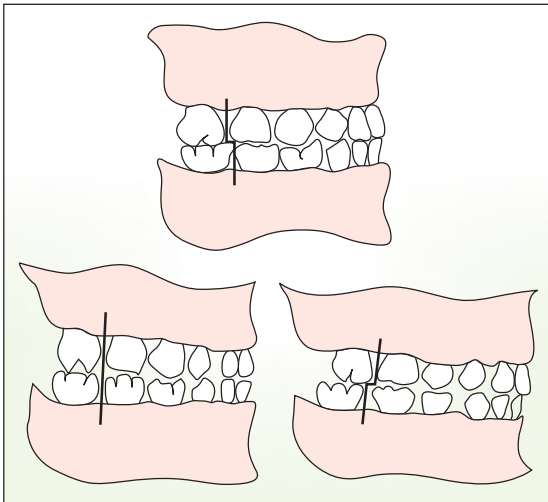
Specify whether the calculus is supragingival or subgingival (Figure 1.36). Also use a simple means to grade the severity of calculus (Figure 1.37).

Calculus +: supra gingival calculus present on the cervical third of the crown of a tooth.

Calculus ++: supra gingival calculus extending upto the middle third of the crown of a tooth.



Figures 1.34A to C



Figures 1.35A to C



Figure 1.36: Supragingival calculus

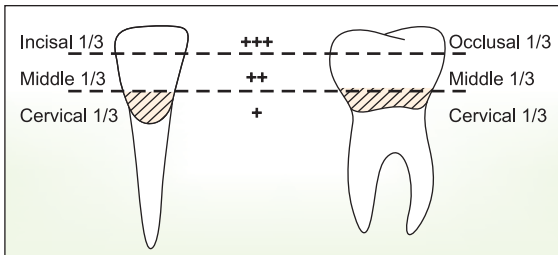


Figure 1.37

Calculus +++: supragingival calculus extending upto the incisal or occlusal third of the crown of a tooth or a thick band of subgingival calculus surrounding the neck of the tooth.

When calculus is present on the occlusal aspects of teeth it signifies that the tooth is not in occlusion or used for masticatory function (unilateral chewing bahit/ infraocclusion/ opposing missing tooth/ deep painful carious lesions) stains should be recorded as extrinsic stains or intrinsic stains. The color of the stain should also be noted. (Extrinsic stains are because of smoking, coffee, tea, chromogenic bacteria and food colors) (Figure 1.38). If the stains are intrinsic in nature (take a detailed history regarding residing in a fluoride belt region, consumption of untreated water, members in the family, locality who have similar discoloration of teeth, history of trauma, consumption of long term medication by the mother during pregnancy (Figure 1.39) and use of medication by the patient during early childhood till around the age of 8 years.



Figure 1.38



Figure 1.39: Dental fluorosis

Fractured Teeth

Make a note of fractures of crowns of teeth. Radicular fractures are generally undetected during clinical examination. Record the surface of the tooth that is fractured. (If anterior teeth are fractured, use Ellis's system of grading fractures). Trauma to the dental structures should always be evaluated with appropriate radiographs.

If posterior teeth are fractured make a mention of whether the crown is fractured in the occlusal or proximal area and the extent of involvement, as in dentinal exposure, pulpal exposure or enamel fracture. Ask the patient for history of trauma, make a note if the tooth is discolored, check for tenderness by percussing the tooth (Figure 1.40). Also check for mobility of teeth.

Others

Make a mention of exostoses, supernumerary teeth. Transposed teeth, natal and neonatal teeth and developmental malformation of teeth (Hypoplasia, Developmental alterations in the number, size, shape and structure of teeth).

Exostoses: They are bony projections that arise from the cortical plates. They are benign and localized in nature. The commonly occurring exostoses are *Torus Mandibularis* and *Torus Palatinus*.

Supernumerary teeth:

A supernumerary tooth in the maxillary anterior incisor region is termed *Mesiodens*. An accessory fourth molar is referred to as



Figure 1.40: Fractured incisor



Figure 1.41

Distodens or Distomolar. A posterior supernumerary tooth present buccally or lingually to a molar is referred to as *Paramolar*. On occasions multiple supernumerary teeth may be seen (Figure 1.41). Supernumerary teeth which resemble other teeth in the arch are termed supplemental teeth.

Developmental malformation of teeth:

Enamel hypoplasia: Is seen as pits, grooves or areas of missing enamel over the tooth surface. Teeth show areas of decreased translucency and increased opacity (dull, chalky white appearance of teeth).

Causes of enamel hypoplasia can be as a result of injuries to teeth during development, antineoplastic therapy, dental fluorosis and congenital syphilis (screw driver edge shaped central incisors and mulberry molars).

Turner's hypoplasia is seen in permanent teeth. Defective enamel is seen as a result of spread of the periapical inflammatory process from the deciduous teeth. Teeth can appear chalky white, yellow or brown in color. Commonly seen in premolars.

Shape of teeth:

Gemination: Is a single enlarged tooth or a joined tooth in which the tooth count is normal when the anomalous tooth is counted as one.

Fusion: Is a single enlarged tooth or a joined tooth in which the tooth count reveals a missing tooth when the anomalous tooth is counted as one (Figure 1.42).

Concrescence: It is the union of two adjacent teeth through their cementum.



Figure 1.42



Figure 1.43

Structure of teeth: Developmental alterations in the structure of teeth include amelogenesis imperfecta, (Figure 1.43) dentinogenesis imperfecta, dentin dysplasia and regional odontodysplasia (ghost teeth).

Natal and neo-natal teeth: Teeth that are evident at birth are termed *natal teeth*. Those teeth that erupt within the first 30 days of birth are referred to as *neo-natal teeth*.

Soft Tissue Examination

Gingiva

Examine the marginal, interdental and attached gingiva. Comment on the color, contour, size, and consistency. Examine whether the gingiva bleeds spontaneously, on palpation or on probing (use a blunt ended probe and walk the probe along the gingival sulcus gently and record sites that reveal bleeding from the gingival sulcus).

Periodontal Pockets

A periodontal probe is used to check periodontal pockets. The probe is placed in the gingival sulcus and “walked” gently along the circumference of the tooth along the sulcus to detect for pockets. However a pseudo pocket formed by merely a gingival enlargement should be distinguished from a true pocket, which occurs as a result of loss of epithelial attachment and pathological deepening of the gingival sulcus.



Figure 1.44

Buccal Mucosa

To examine the buccal mucosa the patient should be instructed to open his mouth to a comfortable extent. The buccal mucosa can be retracted using a mouth mirror, with the mirror surface facing the mucosa. A gloved index finger can also be used to reflect the buccal mucosa for inspection (Figure 1.44). Normally buccal mucosa has a deep pink color. The clinician should inspect for change in color, presence of swellings and patches on the buccal mucosa. The lesion should be palpated in order to assess its consistency, tenderness, and keratotic nature (Figure 1.45).



Figure 1.45: Buccal mucosa showing ulcers

Floor of the Mouth (Fig. 1.46)

The floor of the mouth is best visualized when examining the ventral surface of the tongue. This is done by asking the patient to touch the roof of the palate with the tip of his tongue. Check for pooling of saliva in the floor of the mouth. The best method to palpate the floor of the mouth is by bimanual



Figure 1.46

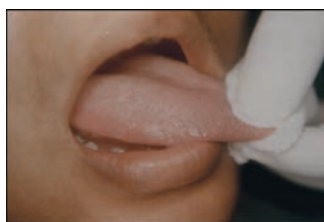
palpation. The Wharton's ducts open through the sublingual caruncles, which lie on either side of the lingual frenum. Check for salivation from the Wharton's ducts. Palpate the sublingual salivary gland, which is located in the anterior part of the floor of the mouth. The submandibular glands lie on the postero-lateral part of the floor of the mouth. Evaluate presence of tori, sialoliths, nodal enlargement and enlargement of the salivary glands.

Vestibule

The labial and buccal vestibules can be inspected and palpated by asking the patient to keep his mouth slightly closed (Figure 1.47). This can be achieved by asking the patient to initially open his mouth wide, as the clinician places his index finger in the vestibule the patient can be instructed to gently close his mouth and try to approximate his teeth. Inspect the vestibules for swellings, ulcers, and obliterations. Palpate the vestibules for tenderness and expansion of cortical plates.

Tongue

The dorsal, ventral and lateral borders of the tongue should be examined. To examine the dorsum of the tongue, the patient can be instructed to protrude the tongue forward keeping the mouth open (Figure 1.48). To inspect the ventral (lower)

**Figure 1.47****Figure 1.48****Figure 1.49****Figure 1.50**

surface, the patient is instructed to touch the roof of the palate with the tip of his tongue (Figure 1.49). In order to check the lateral borders of the tongue, a piece of sterile gauze is wrapped around the tip of the tongue and the tongue is drawn to the desired side (Figure 1.50). The muscular consistency of the tongue can be assessed by bidigital palpation.

Lips

Both the extraoral and intraoral surface of the lips and the angle of the mouth should be examined (Figure 1.51). The extraoral surface of the lips generally appears pale pink in healthy individuals. The intraoral surface of the lips (labial mucosa) appears bright pink. Examine the lips for change in pigmentation, presence of ulcers, swellings, rhagades, crusts and clefts (Figures 1.52 and 1.53).



Figure 1.51



Figure 1.52: Cleft lip



Figure 1.53: Crusted lips (in erythema multiformae)



Figure 1.54

Palate

Hard palate: The hard palate is generally examined by indirect visualization using a mouth mirror. The hard palate is generally pale pink in color (Figure 1.54).

The hard palate is firm on palpation and has a corrugated pattern in the anterior portion. Examine for change in color of the palate, ulcers, midline swellings, swelling along the palatal surface of the gingival margins and clefts (Figure 1.55).

Soft palate: Soft palate in healthy individuals is reddish pink in color. However, the color may vary based on the vascularity. Soft palate is visualised by depressing the tongue using a mouth mirror as a tongue depressor. The soft palate is examined for swellings or ulcers. Generally the soft palate is not palpated unless it is warranted as it may cause a gagging sensation in the patient.



Figure 1.55: Petechiae on the hard palate



Figure 1.56: Uvula and faucial pillar region

Tonsils and Oropharynx

The best visualization of the oropharynx in a dental setting can be got by depressing the tongue with a mouth mirror and instructing the patient to say, “aah”. The posterior pharyngeal wall, tonsillar pillars and the uvula are examined. Note presence of erythema, ulcers enlargement of tonsils and exudate from the tonsillar crypts (Figure 1.56).

Examination of the Lesion

Based on the requirement extraoral and/or intraoral examination of the lesions are carried out. When examining for extraoral lesions, make a note of facial asymmetry, swellings, ulcers, and sinus openings. Comment on the location, size, extent, surrounding skin, raise in local temperature, tenderness, fixity and consistency. Intraoral lesions are examined with gloved hands. Note the site of the lesion, extent, margins, surrounding mucosa, tenderness and scrapability. Examination of the temporomandibular joint may require auscultation. The bell-end of the stethoscope is placed over the joint and patient is advised to open and close his mouth gently. The presence of crepitation and clicks are recorded.

Vitality Tests

Vitality tests can be performed on teeth that are suspected to have pulpal pathology.

For example: discolored teeth, teeth with history of trauma or extensive restorations can be subjected to vitality tests.

Provisional Diagnosis

It is a clinical diagnosis or tentative diagnosis that is given after corroborating the facts recorded in the history and the findings of the clinical examination. A provisional diagnosis can also be given for other findings in the oral cavity. However the first item on the provisional diagnosis list should pertain to the chief complaint.

For example: If the chief complaint is of pain in the lower right back tooth for the past 5 days and on clinical examination apart from a carious lower right first molar that is tender on percussion, if a white keratotic patch is present on the left buccal mucosa with a history of using tobacco, then the provisional diagnosis should read:

1. Apical periodontitis with respect to 46 (FDI nomenclature)
2. Homogenous Leukoplakia on the left buccal mucosa

Differential Diagnosis

They are list of conditions that resemble the clinical diagnosis but differ from the clinical diagnosis by at least one feature.

For example: If the clinical diagnosis is Apical periodontitis Differential diagnosis can be chronic irreversible pulpitis and periapical abscess. If the clinical diagnosis is Homogenous leukoplakia, differential diagnosis can be chronic hyperplastic candidiasis and white sponge nevus.

Investigations

Investigations can broadly be grouped into Hematological Investigations, Serum chemistry evaluation, Histopathological investigations and Radiographic investigations.

Investigations are needed in order to help the clinician confirm his clinical diagnosis, to detect a suspected systemic illness and to help modify the treatment plan.

Final Diagnosis

It is the diagnosis that is made after required investigations are carried out. In some instances the clinical diagnosis and the

final diagnosis may be different. The clinical impression is almost always a tentative diagnosis. Once the final diagnosis is arrived at, a suitable treatment plan is chalked out.

Treatment Plan

The dentist should weigh various factors before formulating an effective treatment plan. The treatment plan for every patient is unique and need not necessarily be of use in managing a similar problem in another patient. However, it is a well understood fact that treating the chief complaint on a priority basis will help the oral physician gain the confidence of the patient. On the other hand other urgent problems that need to be dealt with immediately should not be circumvented. The treatment plan can be divided into multiple phases.

Phase I: Emergency Phase

Management of pain, and acute infections using analgesics and antibiotics

Incision and drainage of abscesses, Palliative pulpotomy, reduction of fractures

Phase II: Surgical Phase

Extraction of teeth with poor prognosis (root stumps, grossly decayed teeth, mobile teeth)

Biopsies, enucleation of cysts, resection of tumors.

Phase III: Prophylactic Phase

Scaling and root planing, gingival curettage, pocket elimination, bone graft procedures

Phase IV: Restorative Phase

Endodontic treatment for asymptomatic teeth, Restoration of teeth

Phase V: Corrective Phase

Fabrication of prosthesis for missing teeth, Orthodontic correction of malaligned teeth

Phase VI: Recall and Review

Prognosis

Prognosis may be defined as the prediction of the course, duration and termination of the disease and its response to treatment. Prognosis of a disease process should be made after the final diagnosis is made and based on the prognosis of the condition an effective treatment plan can be formulated. For example: A tooth with gingival recession with mobility and furcation involvement has a poor prognosis for being used as an abutment tooth for fixed partial denture prosthesis. A diabetic with periodontal disease has a *poor prognosis* however a healthy individual with periodontal disease has a *fair prognosis*.

CASE ANALYSIS SUMMARKOY

A brief summary of the case is written in the case analysis. Only important facts in the history and clinical examination are noted that helped in arriving at the clinical diagnosis. The investigations carried out and the treatment protocol planned is mentioned.



Evaluation of Patients with Special Care Needs

Certain precautions are to be followed when the oral physician examines patients like pregnant women, child patients, patients who are physically and mentally challenged and patients who are suffering from infectious conditions like Hepatitis and HIV. These patients may require special care, attention and certain modifications in the treatment protocol.

PATIENTS WITH MENTAL OR PHYSICAL DISABILITIES

Disability refers to any impairment that limits daily activity in some manner, which can be *developmental in origin* or *acquired*.

Developmental disabilities: They are the conditions that are identified in early childhood and usually persist throughout life such as cerebral palsy, Down syndrome, mental retardation, autism, hearing and visual impairments and congenital defects.

Acquired disabilities: Disabilities that are acquired later in life such as neuromuscular disorders, traumatic injuries causing disability and psychiatric disorders.

Management of patients with mental or physical disabilities

General guidelines: Majority of the patients with a physical or mental disability can be treated in a dental office without any modification in the routine protocol. However, the oral physician should evaluate the patient's ability to co-operate during the treatment procedure, the functional status of the patient and the best method of communication.

1. *Patient should be involved totally* into the treatment planning, limited only by his or her own mental or physical disability.
2. *Motivating the patient* should be the key parameter as it decides the success or failure of the treatment plan.
3. *Informed consent should be taken* from the patient before commencing any dental procedure. If the patient is legally incompetent, the patient's legal guardian may be required to give the consent.
4. *Communication with the patient* is important as it decides the outcome of any dental procedure.

For the visually impaired, the oral physician can verbally describe the dental procedure involved. The heightened sense of touch in these patients can be utilized to explain the dental procedure.

For the hearing impaired, visual demonstration of the dental procedure or sign language can be used to communicate effectively.

In patients with mental retardation or cognitive disabilities, the oral physician should use repetitive commands in a normal tone.

Oral Conditions Specific to Mental/Physical Disabilities

Mental Retardation and Cognitive Disabilities

These individuals generally have a higher incidence of dental caries and periodontal diseases. There is also a higher incidence of delayed eruption and presence of over retained deciduous teeth. Some patients may present with orthodontic irregularities as a result of abnormal oral functions.

They could also have deleterious oral habits such as *rumination, pouching, pica, self-harm and bruxism*.

Rumination: Regurgitation, re-chewing and re-swallowing of previously ingested food is referred to as rumination. This causes the acidic contents of the stomach to come in contact with teeth.

Oral findings: Erosion of teeth, rampant caries, and destruction of composite restorations.

Pouching: Retaining of food, medicines or other substances in the buccal vestibule for lengthy periods of time.

Oral findings: multiple decayed teeth.

Pica: It is a compulsive eating or craving for nonedible substances like sand, cigarette butts, gravel, etc.

Oral findings: fracture of teeth, attrition of teeth, gingival and soft tissue trauma.

Bruxism: Bruxism is the nonfunctional contact of teeth. (unconscious clenching or tapping of teeth).

Malocclusion, occlusal interferences, high points on restorations, nutritional deficiencies, parasitic infestations of the intestine, food allergies and endocrinal disturbances have all been implicated in the causation of Bruxism.

Oral findings: Wearing away of the occlusal surfaces of teeth, tender muscles of mastication, headaches and temporomandibular dysfunction are the features seen in Bruxism.

Down syndrome: It is a chromosomal abnormality associated with subnormal mentality.

Oral findings: Increased prevalence of periodontal disease

- Low prevalence of dental caries
- Delayed eruption and over retained primary teeth
- Macroglossia

Autism

Autism is a developmental disorder characterized by poor social skills, abnormal speech and language, repetitive stereotyped activities and behavior problems.

Clinical features

Patients prefer soft, sweet diet, which requires minimal chewing. Oral trauma due to self inflicted injuries.

Psychiatric Disorders

Generally the clinical features are due to the side effects of pharmacotherapy. The side effects of medications involve xerostomia, increased caries incidence, increased incidence of periodontal diseases, candidal infection, mandibular tics, peri oral muscle spasms and impaired gag reflex. Hypochondrial delusions are common such as “worms in the mouth”, “unbearable facial pain”, etc.

Cerebral Palsy

It is a disorder caused by brain damage during the period of development involving areas of the brain concerned with movement and posture (motor deficits).

Clinical features: Patients exhibit bruxism, drooling of saliva and lowered caries index. Some patients show enamel hypoplasia and mouth breathing habit.

Degenerative Neuromuscular Disorders

These diseases affect the nervous and muscular system leading to degeneration and progressive atrophy characterized by muscle spasticity, weakness and paralysis such as multiple sclerosis, muscular dystrophy and Parkinson's disease.

Clinical features of multiple sclerosis: Temporomandibular joint dysfunction, facial neuralgia, increased incidence of caries, periodontal disease and occlusal wear facets.

Clinical features of Parkinson's disease: Drooling (of saliva) because of inadequate swallowing of saliva. Abnormal tongue posture and poor oral muscle function.

Treatment Planning for Patients with Mental/Physical Disabilities

Patients suffering from severe disabilities or underlying systemic illness have to be evaluated by a general physician prior to the commencement of any form of dental treatment.

Before beginning any active dental treatment it is advisable to have a preliminary evaluation of the patient by the oral physician. In this appointment a note of the severity of the disability and the patient's ability to cooperate is evaluated. In doing so the best method of communication and the functional status of the patient can be decided.

Managing the Patient's Behavior

In most instances patients are cooperative to the extent of allowing basic dental treatment. Some patients may require the use of professionally recognized behavior management techniques such as physical restraint, use of pharmacological agents and general anesthesia to facilitate dental treatment.

Physical restraint: The restraint used should not cause bodily harm to the patient and should be as less discomforting to the patient as possible. Before the technique of constraint is used consent should be taken from the patients attenders. The techniques of restraint may vary from a simple technique (Figure 2.1) to prevent the patient's hand from interfering with the procedure to a full body restraining device.



Figure 2.1

Use of pharmacological agents: Sedating agents such as Benzodiazepines in therapeutic doses can be used to provide conscious sedation to patients who do not respond favorably

to verbal communications and those patients who display an obvious anxiety and emotional discomfort towards dental treatment. These agents are used to minimize the anxiety and calm the patient without inducing sleep.

Use of general anesthesia: General anesthesia is rarely used to manage patients with mental or physical disabilities. Patients who need extensive dental procedures and in those patients who cannot be managed by regular behavior management techniques can be selected for treatment under general anesthesia.

Dental Procedures

Unlike regular patients who are recalled every 6 months for an assessment of their periodontal health, patients with mental and physical disabilities need an evaluation at shorter intervals to assess the periodontal status and to institute an appropriate oral hygiene program specific to the needs of the patient. The caretaker of the patient should be motivated to help the patient maintain adequate oral hygiene.

Traditional restorative materials like silver amalgam and composites can be used to restore teeth. Deciduous teeth with extensive carious lesions on the posterior teeth can be retained until the eruption of permanent teeth using stainless steel crowns.

Oral surgical procedures are not specifically contraindicated for patients with mental and physical disabilities. But necessary modifications in the technique employed may have to be carried out for certain patients.

Prosthetic replacement of missing teeth should involve a judicious selection of the patient and the prosthesis, as it plays a key role in the success of such a prosthetic replacement.

Use of removable denture prosthesis may necessitate the patient or his caretaker to remove the prosthesis as per the instructions and clean it on a regular basis. However such removable denture prosthesis may not be indicated for patients with poor muscular control and cognitive skills. Patients who can maintain adequate oral hygiene, may be given fixed denture prosthesis.

MANAGEMENT OF THE PREGNANT PATIENT

Hormonal changes during the period of pregnancy will cause changes in the body and the oral cavity is no exception. All elective dental procedures can be delayed until post partum to avoid any risk to the developing fetus, but it is important to maintain the pregnant woman's current state of dental health while educating her about common problems that may be noticed during pregnancy.

Period of Pregnancy

Pregnancy may be divided into three stages

Zygote- from the time of fertilization to implantation (approximately upto 2nd week)

Embryonic period- from the second week to the eighth week

Fetal period- after the eighth week upto parturition

For practical purposes pregnancy may be divided into three trimesters

First Trimester (Period of Active Organogenesis)

The fetus is at a great risk to the effects of teratogens and in the first trimester almost one in five pregnancies undergo spontaneous abortion.

Dental considerations: Dental treatment is best *avoided* during the first trimester. However it is the right time to assess the current oral health of the patient and to educate her regarding the oral changes that she should expect during the period of pregnancy.

1. *Nausea and vomiting* – Caused by increased levels of gonadotropins in the first trimester
2. *Enamel erosion*– Gastric acids present in the vomitus erode particularly the lingual surfaces of anterior teeth. (Increased levels of progesterone as a result of a central acting mechanism causes delayed gastric emptying). Patients can be advised to rinse their mouth thoroughly with an oral rinse containing sodium bicarbonate after a vomiting

episode, which neutralizes the residual acid remaining on teeth.

3. *Pregnancy induced gingivitis*- The gingival changes in the pregnant woman begin around the second month and continue to term.

Gingival changes in pregnancy are thought to be brought on by two factors.

- a. Increase in the metabolism of estrogens by the gingiva may increase sensitivity to local irritants like plaque and food debris causing inflammation.
- b. Increased synthesis of prostaglandins induced by pregnancy, results in increased sensitivity to inflammation.

Second Trimester

Organogenesis is complete and the risk to the fetus is at its lowest.

Dental considerations: The second trimester is the safest period for any necessary elective dental treatment.

1. *Pregnancy tumor*: It is also referred to as Granuloma Gravidarum (Figure 2.2). It usually develops in the second trimester of pregnancy and generally resolves on its own after delivery. Histologically, it resembles a pyogenic granuloma. The pregnancy tumor occurs on gingiva lips, tongue and buccal mucosa. However, commonly seen on



Figure 2.2

the facial aspects of gingiva of upper anterior teeth, typically located in the interdental regions and may bleed on minimal provocation. This lesion rarely requires excision except in cases where the tumor impedes mastication or hinders routine dental care.

Third Trimester

Dental treatment is *not recommended* in the third trimester. During the third trimester the fetus grows to a potentially uncomfortable size that makes it difficult for the mother to remain still for prolonged periods of time. As the uterus expands with the growing fetus and placenta, the fetus comes to lie directly over the inferior vena cava, femoral vessels and the aorta.

Dental considerations:

1. *Patient positioning in the dental chair:* The ideal position for the pregnant patient is the sitting position or a left lateral position in the dental chair. Supine position is best avoided as the weight of the gravid uterus could apply pressure over the inferior vena cava, femoral vessels and the aorta thereby leading to a condition referred to as supine hypotension. In supine hypotension, the blood pressure drops because of the impeded blood flow, which results in a syncopal or a near syncopal attack. This condition can be immediately managed by turning the patient to the left lateral position and elevating the head of the dental chair (Figure 2.3)



Figure 2.3

General Guidelines

Women of childbearing age should be included under the precautions that are taken for pregnant women. During the first few weeks after conception, the patient may have no knowledge of being pregnant, making it prudent for the oral physician to inquire about the last menstrual period. It is recommended that the patient be referred to a medical physician to confirm the pregnancy.

1. A detailed history including the number of times the patient has been pregnant, number of children conceived and history of abortions (spontaneous or elective) should be recorded.
2. All appointments should be kept short and the best chair position is sitting up or left lateral position with the head of the chair elevated (avoid supine position).
3. Elective dental treatment should ideally be deferred to post term.
4. Second trimester is the preferred period for any necessary dental treatment (oral prophylaxis, restoration of carious teeth, etc.).
5. Dental radiographs are best avoided. If unavoidable, second trimester is preferred. The amount of radiation to the fetus is negligible with dental radiographs. However, it is mandatory to use lead aprons and thyroid shields. Although the dental radiographs require very minimal exposure, it is wise to reduce the exposure time even further and compensate the lowered exposure time with a prolonged processing time.
6. Prescription of drugs should be done with the utmost precaution and care. Some of the drugs that are known teratogens and which are said to pose a significant risk to the developing fetus are Busulphan, Carbamazepine, ACE inhibitors, Phenytoin, Methotrexate, Tetracycline, Valproic acid, Cyclophosphamide, Pencillamine, Isotretinoin, Alcohol, Lidocaine and Trimethadione.

Effects of Drugs on the Pregnant Patient

The Food and Drug Administration (FDA, USA) formulated a five-category system of classification of drugs, which helps the

physician to decide the potential risks of every drug that he or she prescribes to a pregnant woman.

Food and Drug Administration Classification System

- A** - Controlled studies showed no risk to the fetus. This group is limited to multivitamins and prenatal vitamins, not megavitamins
- B** - Either animal studies have shown no fetal risk, but there are no controlled human studies during pregnancy, or animal studies have shown adverse effect that was not confirmed in controlled studies during the first trimester. Penicillins are in this family.
- C** - There are no adequate studies, or animal studies have shown adverse effects, but controlled studies in women are not available. Potential benefit must be greater than the risk to the fetus if these medications are used
- D** - Evidence of fetal risk is proven, but potential benefit must be thought to outweigh the risks
- X** - Proven fetal risk clearly outweighs any potential benefit

Table 2.1: Commonly used drugs and their effects in pregnant women

<i>Drug</i>	<i>FDA Category</i>	<i>Crosses Placenta</i>	<i>Effects in 1st trimester</i>	<i>Effects in 2nd trimester and 3rd trimester</i>
Analgesics				
Acetaminophen	B	Yes	No	No
Aspirin	C	Yes	High doses causes intra uterine growth retardation, perinatal mortality and teratogenic effects	Prolonged gestation, labor and problems with maternal and newborn hemostasis
Ibuprofen	B		No	May prolong labor and pregnancy

contd...



contd...

Morphine	B	Yes	No	Can produce neonatal respiratory depression
Codeine	C	Yes	associated with various malformations	Can produce neonatal respiratory depression

Antibiotics

Ampicillin	B	Yes	No	No
Penicillin G	C	Yes	No	No
Penicillin V	B	Yes	No	No
Metronidazole	B	Yes	Mutagenicity in rodents (human studies not conclusive)	No
Clindamycin	B	Yes	0.01-10% risk of pseudo-membranous colitis	0.01-10% risk of pseudo-membranous colitis
Gentamycin	C	Yes	Ototoxicity	Ototoxicity
Erythromycin	B	Yes	Hepatotoxicity during pregnancy	Hepatotoxicity during pregnancy
Sulfonamides	B	Yes	No	Hyperbilirubinemia in the neonate
Trimethoprim	C	Yes	Theoretical risk of teratogenicity	Yes
Cephalexin	B	Yes	No	No
Cefazolin	B	Yes	No	No
Tetracycline				

Local anesthetics

Lidocaine	C	Yes	No	High doses during labor causes CNS depression in the neonate
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contd...

contd...

Bupivacaine	C	Yes	May cause cardiovascular collapse	May cause cardiovascular collapse
Mepivacaine	C	Yes	No	No
Adrenergic agent				
Epinephrine	C	Yes	Large doses may decrease uterine blood flow	Large doses may decrease uterine blood flow
Anticoagulant				
Heparin	C	Yes	No	No

PATIENTS REQUIRING ANTIBIOTIC PROPHYLAXIS

It is well known fact that certain dental procedures, which induce bleeding, may lead to transient bacteremia. However, only very specific conditions warrant the use of antibiotic prophylaxis.

Clinical Conditions Which Require Antibiotic Prophylaxis

Cardiac Conditions

Previous history of bacterial endocarditis
 Prosthetic cardiac valves
 Complex cyanotic congenital heart diseases
 Surgically constructed systemic pulmonary shunts
 Acquired valvular dysfunction
 Hypertrophic cardiomyopathy
 Mitral valve prolapse with regurgitation

Neurosurgical Shunts

Shunts are placed in patients with hydrocephaly in order to help in the drainage of cerebrospinal fluid (CSF). The ventriculoatrial shunt allows drainage of the CSF from the lateral ventricles to the venous circulation. The ventriculo peritoneal shunt helps drain the CSF into the abdominal cavity.

Indwelling Catheters and Stents

Antibiotic prophylaxis is indicated only in instances where the catheters are on the right side of the heart. Only the first two weeks are critical and indicated for antibiotic prophylaxis when stents are placed in cardiac patients. The risks of developing a super infection are very minimal after the first few weeks as an epithelial layer develops over these stents.

Patients with Renal Diseases Undergoing Hemodialysis

Patients receiving peritoneal dialysis do not require antibiotic prophylaxis. However, patients who have an *arteriovenous shunt* (made up of autogenous tissue or a silastic tube) implanted for dialysis require antibiotic coverage during dental procedures, as these shunts are vulnerable to infection.

Patients with Compromised Immune Status

These patients are more prone to develop an overwhelming septicemia from a relatively harmless transient bacteremia because of their compromised immune status.

Patients undergoing chemotherapy are prone to develop infections as the chemotherapeutic agents suppress the inherent immune system. Invasive dental procedures such as extraction of teeth, subgingival scaling and periodontal surgeries that might cause significant bleeding warrant antibiotic prophylaxis in these patients.

Patients infected with Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS) generally do not require antibiotic cover, nevertheless it is always wise to perform dental procedures such as extraction of teeth and periodontal surgeries under antibiotic cover as it might minimize the risk of the patient acquiring a super infection.

Patients with uncontrolled Insulin Dependent Diabetes Mellitus (IDDM) are vulnerable to infections. Invasive dental procedures that involve significant amount of bleeding may also require antibiotic cover.

Dental Procedures that Require Antibiotic Cover

1. Extraction of teeth
2. Periodontal procedures (gingival probing, supra and subgingival scaling, root planing and periodontal surgery)
3. Intraligamentary local anesthetic injections
4. Endodontic instrumentation or endodontic surgery beyond the tooth apex
5. Reimplantation of teeth and placement of dental implants
6. Placement of orthodontic bands and *not brackets*
7. *Subgingival placement of antibiotic strips and fibers*

Dental Procedures that do not Require Antibiotic Cover

1. Local anesthetic injections (except intraligamentary injections).
2. Restoration of teeth with/without gingival retraction cord
3. Postoperative suture removal
4. Root canal treatments (not beyond apex), placement of post and core build up.
5. Adjustment of orthodontic appliances.
6. Placement of rubber dams, taking oral impressions
7. Fluoride applications
8. Placement of removable prosthodontic or orthodontic appliance
9. Taking oral radiographs

Table 2.2: Antibiotic prophylactic regimens (from Journal of the American Dental Association, Vol.131, March 2000)

	<i>Antibiotic</i>	<i>Regimen</i>
Standard Prophylaxis	Amoxycillin	<i>Adults:</i> 2 grams <i>Children:</i> 50 mg/kg body weight Orally one hour before the procedure
Patients unable to take oral medication	Ampicillin	<i>Adults:</i> 2 grams IM or IV <i>Children:</i> 50 mg/kg body weight IM or IV Within 30 minutes before the procedure

contd...

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Patients who are allergic to Penicillin	Clindamycin	<i>Adults:</i> 600 mg <i>Children:</i> 20 mg/kg body weight Orally one hour before the procedure
	Cephalexin	<i>Adults:</i> 2 grams <i>Children:</i> 50 mg/kg body weight Orally one hour before the procedure
	Azithromycin or Clarithromycin	<i>Adults:</i> 500 mg <i>Children:</i> 15 mg/kg body weight Orally one hour before the procedure
Patients allergic to penicillin and who cannot take oral Medication	Clindamycin	<i>Adults:</i> 600 mg <i>Children:</i> 15 mg/kg body weight, IV 1 hour before the procedure
	Cefazolin	<i>Adults:</i> 1 gram <i>Children:</i> 25 mg/kg body weight IM or IV 30 minutes before the procedure

EXAMINATION OF THE CHILD PATIENT

Managing a child patient in a dental set up is a challenging task for the physician. Understanding the behavior pattern will help the oral physician to customize examination protocol for every single patient.

Child Patient's Behavior

A child patient's behavior can be broadly categorized as:

1. Co-operative
2. Non co-operative
3. Potentially co-operative

Co-operative Patient

Most children visiting the physician belong to this group. These children exhibit a reasonable level of co-operation. Patients of this category appear relaxed and may have minimal apprehensions about the oral examination.

Non co-operative Patient

Generally children below the age of 3 years and children who are physically and mentally challenged fall into this category. Establishing communication with these patients is the most difficult task.

Potentially Co-operative Patient

Like the name suggests these children appear to be non co-operative but with adequate stimulation the behavior of these children can be modified to make them co-operative.

There are six forms of potentially co-operative behavior

- a. Stoic behavior
- b. Defiant behavior
- c. Whining behavior
- d. Uncontrolled behavior
- e. Timid behavior
- f. Tense co-operative behavior

Defiant behavior: These children are referred to as being “spoilt” and “stubborn”. The child portrays a totally negative attitude towards the dental treatment. They slump in the dental chair and will not respond to any form of verbal communication. The child usually will clench his teeth tightly and may not open his mouth for an oral examination.

Whining behavior: The oral physician should exhibit a great deal of patience when examining these children. These children will allow an oral examination but will whine through out the examination. They generally have a controlled cry that is constant and usually not loud. They are rarely known to shed tears.

Uncontrolled behavior: Uncontrolled behavior is labeled as a form of *tantrum*. These children are usually in the 3-6 year age group. The child may cry out loudly, shed tears and lash out his legs and arms. It generally depicts a state of fear and anxiety in the child.

Timid behavior: Children of this group are highly anxious and must be dealt with the utmost care. The child should be helped to develop confidence and trust in the dentist. Over protective home environment and children living in an isolated surrounding tend to develop this behavior. Improper management of these patients can make them uncontrollable. These children do not respond immediately to instructions given by the oral physician.

Tense co-operative behavior: Child patients of this category accept dental treatment but can exhibit an overt anxiety. These children may perspire on their feet and palms. These children generally control their behavior during the examination procedure but may vocalize their dislike towards the procedure at a later stage.

Child Management in a Dental Setting

1. A warm and friendly environment should be maintained when a child patient is being examined.
2. The oral physician should be extremely patient.
3. For very young patients, the person accompanying the child can be instructed to sit in the dental chair and hold the child comfortably and firmly to facilitate unobstructed examination
4. As far as possible the child patient should be examined in a place where he/she does not get to see other patients in pain
5. It should be ensured that almost all conversations should be directed towards the child and it should be in a very simple and understandable language
6. At no point of time the child should be left alone in the dental chair
7. It is recommended to praise the child for good behavior. However, bribery should be strictly avoided.

8. A child may be allowed to familiarize himself/herself with the routine diagnostic instruments like mouth mirrors and blunt ended probes. They may be shown the functioning of the light attached to the dental chair.
9. A Tell Show Do (TSD) technique may be employed to gain the co-operation of the child. For example, a mouth mirror can be shown to the child and told the uses of it and finally use it to examine the patient's oral cavity.
10. Modeling technique can be employed in potentially co-operative patients. An older child can be asked to sit on the dental chair and the use of common diagnostic instruments can be demonstrated to the younger child.
11. Based on the behavior of the child the physician can use voice control to manage the child. The oral physician can modulate his voice based on the behavior of the patient. Voice control can be used in children who tend to display delaying tactics such as wanting to spit continuously or wanting to go to the toilet often.
12. Hand over mouth exercise (HOME) is employed in children who display whining or uncontrolled behavior. The physician places his/her palm over the child's mouth ensuring that the breathing is not impaired and then gentle soothing words are spoken into the child's ears. Once the child ceases to cry the palm over the child's mouth can be removed and the examination can be continued.
13. Generally physical restraints are employed when no other methods of managing the child help. An un-cooperative child can be restrained by the patient's caretaker, using belts and tapes. Physically and mentally challenged patients can be restrained using sheets, papoose boards, mouth gags and props.
14. When all of the above mentioned methods fail a child can be managed by using antianxiety drugs and general anesthesia.

Drug Dosage in a Child Patient

Dosage for a child patient can be calculated from the adult drug dosage using either of the formulae

Youngs formula:

Child dose = (Age of the child in years) divided by (Age of the child +12) $\times$ adult dose

Dillings formula:

Child dose = (Age of the child in years) divided by 20 $\times$ adult dose.

Alternatively the drug dosage for a child can be accurately calculated based on the body weight of the child.

Table 2.3: Drug dosage based on the body weight of the child

<i>Age of the child</i>	<i>Ideal body weight (kilograms)</i>	<i>% of the adult drug dosage</i>
New born	3.2	12.5
1 month	4	15
3 months	5.5	18
6 months	7.5	22
1 year	10	25
3 years	14	33
5 years	18	40
7 years	23	50
12 years	37	75

MANAGEMENT OF PATIENTS WITH HUMAN IMMUNODEFICIENCY VIRUS (HIV)

The demand for dental care by individuals infected with HIV is on the rise. However, dental care professionals are still reluctant to treat these patients, despite the fact that there is an extremely low likelihood of professional transmission, which occurs only in patients with extremely elevated levels of viral load. It is necessary that the clinician familiarizes himself/herself with the universal safety precautions and identification of common HIV associated diseases affecting the oral and para oral structures.

A major problem for seropositive individuals has been the reluctance of some dental professionals to treat them, because of the risks of HIV exposure. However, greater understanding of the transmission mechanisms of the virus has led to increased acceptance of these patients by the dental physicians.

The likelihood of occupational transmission among health professionals is 0.3% after percutaneous exposure to infected blood and 0.09% after exposure to mucosa. Other transmissible pathogens namely hepatitis B virus, hepatitis C virus, Cytomegalovirus and Epstein-Barr virus pose a great risk to health care professionals. It is therefore necessary to use barrier techniques and religiously follow all safety measures for the treatment of all patients. Thus all patients should be regarded as potentially infectious and the universal precautionary measures should be adopted. These universal precautions involve the use of latex gloves (two pairs of gloves for surgical interventions), impermeable masks, protective eye wear and covering the surfaces of the dental unit with disposable plastic sheets. Some clinicians recommend the use of antiseptic mouth rinses (0.12% chlorhexidine digluconate for 10 seconds) prior to commencement of an oral examination. Hands should be washed with a liquid antiseptic soap and dried using disposable towels.

Clinical Evaluation of a HIV Positive Patient

1. Follow universal guidelines of precaution.
2. Preferably use disposable mouth mirrors and probes.
3. A complete medical history should be obtained.
4. A thorough clinical examination of the oral and para oral structures should be undertaken
5. Investigations should include a complete hemogram, including the differential leukocyte count. If surgical procedures are planned then the platelet count is important. The platelet count should be over 50,000/mm³ of blood if surgical procedures are planned.
6. The viral load (number of HIV-1 RNA copies) and the CD4, CD8 lymphocyte count should be assessed.

Table 2.4: Clinical staging of HIV based on CD4 count

<i>Clinical stage</i>	<i>CD4 count</i>	<i>duration</i>
Acute infection	1000 to 750	1-4 weeks
Asymptomatic	750-200	2-15 years
Early symptomatic	500 to 100	1-5 years
Late symptomatic	50 to 200	1-4 years
Advanced disease	50 to 0	0-2 years

Table 2.5: Clinical manifestations in HIV based on CD4 count

<i>CD4 count</i>	<i>Clinical findings</i>
Greater than 500/mm ³	Persistent generalized lymphadenopathy Aseptic meningitis Polymyositis Guillain-Barré syndrome
200 to 500/mm ³	Pneumococcal pneumonia Pulmonary tuberculosis Thrush Kaposi Sarcoma Anemia Idiopathic thrombocytopenic purpura Oral hairy leukoplakia B cell lymphoma Cervical intraepithelial neoplasia
Less than 200/mm ³	Disseminated or Chronic herpes simplex Miliary or intrapulmonary tuberculosis Candidal Oesophagitis Peripheral neuropathy HIV associated dementia Coccidioidomycosis
Less than 50/mm ³	Disseminated <i>M. avium</i> Cytomegalo virus retinitis

Oral Manifestations of HIV Infection

Oral and para oral lesions are common in patients infected with HIV. These findings signify a deterioration in the general health of the individual.

Based on the clinical findings the oral disorders affecting HIV infected individuals can be broadly classified as:

1. More common disorders
2. Less common disorders

More Common Disorders

- a. *Fungal infections* – Candidiasis
- b. *Bacterial infections*- HIV associated gingivitis, periodontitis and Necrotizing gingivitis.

- c. *Viral infections*- Herpes simplex virus infections, Varicella zoster virus infections and Epstein-Barr virus infections (including hairy leukoplakia).
- d. *Neoplasms*- Kaposi's sarcoma

Less Common Disorders

- a. *Fungal infections* – Aspergillosis, Histoplasmosis and Geotrichosis
- b. *Bacterial infections*- *Mycobacterium avium* intracellulare, *Klebsiella pneumoniae*, *Escherichia coli*, *Salmonella enteritidis* and sinusitis
- c. *Viral infections*- Human papilloma virus infections, Cytomegalovirus infections
- d. *Neoplasms*- Non-Hodgkin's lymphoma, squamous cell carcinoma
- e. *Lymphadenopathy*
- f. *Neurological disturbances*- Paraesthesia, facial palsy, hyperaesthesia, dysphagia
- g. *Miscellaneous*- Recurrent aphthous ulcerations, delayed wound healing, thrombocytopenia, xerostomia, hyperpigmentation, exfoliative cheilitis and lichenoid reactions

More Common Oral Manifestations in HIV Infected Individuals

Oral Candidiasis

Oral candidiasis is often the initial manifestation of the symptomatic phase of HIV. Usually the presence of oral candidiasis implies the concurrent presence of oesophageal candidiasis.

It is a predictor of likelihood of other opportunistic infections. The presence of oral candidiasis in a young patient without a local cause such as xerostomia, or therapy with antimicrobials, corticosteroids or other immunosuppressive drugs is strongly suggestive of HIV infection.

Types of candidiasis seen in HIV infection: Pseudo membranous candidiasis (oral thrush) is the most common oral lesion that is

seen in HIV infection. However, other forms of candidiasis such as erythematous and hyperplastic candidiasis, angular stomatitis and median rhomboid glossitis are also seen (Figure 2.4).

Erythematous candidiasis is usually the most common early oral manifestation of HIV infection. It presents as a pink or red macular lesion that is seen on the dorsal aspect of the tongue and palate. Hyperplastic candidiasis is seen on the buccal mucosa and presents as white keratotic plaques (Figure 2.5).

Management of oral candidiasis in HIV infection: Management of oral candidal lesions in HIV infected individual should be taken up on a priority basis because these foci act as reservoirs of organisms for local spread of disease.

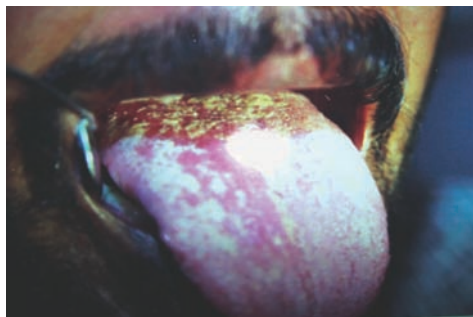


Figure 2.4



Figure 2.5

- a. *Managing underlying xerostomia*: Initial management should be aimed at treating the underlying cause of xerostomia. Bethanecol, 25 mg three times a day can be used effectively.
- b. *Management of candidal lesions*: Topical antifungal agents such Clotrimazole can be used. However, owing to the underlying immune deficiency state relapses are a common feature.

Systemic antifungals can be used in individuals who exhibit poor compliance with regards to regular timely topical application of the antifungal agent.

Ketoconazole 200 mg per day is often used. It should be taken along with food because gastric acid is essential for the dissolution and absorption of ketoconazole. The adverse effects of ketoconazole are nausea, skin rashes, pruritis, liver damage and adrenal suppression.

Fluconazole can be used as an alternate. It is well tolerated and has a longer half-life. A single oral dose of 150 mg per day is said to be effective. Individual studies have shown that oral rinses with Chlorhexidine gluconate may also have some benefit.

Herpes Simplex Virus (HSV) and Varicella Zoster Infections

Most oral and perioral herpes simplex infections are caused by HSV-1, but there are occasional reports of HSV-2 associated lesions in HIV infected individuals (Figure 2.6). Oral infection caused by Varicella Zoster virus in HIV infected individuals is relatively uncommon.

Management: Acyclovir 1-4 gm per day is the generally accepted therapy in HIV positive patients. When HSV is resistant to acyclovir, foscarnet can be used. However, foscarnet can cause oral ulcerations. Dental literature reveals reports of cimetidine being beneficial in treating oral HSV lesions in HIV infected patients.

HIV associated Gingival and Periodontal Diseases

HIV related gingivitis is an early finding in HIV infected individuals. This initial lesion may progress to HIV associated periodontitis.



Figure 2.6

HIV related gingivitis is characterized by marginal gingivitis with diffuse red lesions or a distinct linear marginal erythema associated with petechiae. Gingiva tends to bleed spontaneously.

Necrotising gingivitis may be superimposed on or may precede HIV related gingivitis/periodontitis. Necrotising gingivitis is characterized by extensive tissue loss with rapid progression associated with severe pain, interproximal necrosis and deep periodontal pockets.

HIV related periodontitis is seen in individuals with low T4/T8 (CD4 /CD8) ratios. The organisms isolated from these lesions include *Bacteroides gingivalis*, *Bacteroides intermedius*, *Fusobacterium nucleatum* and *Actinobacillus actinomycetemcomitans*.

Management: Local debridement to eliminate plaque and calculus.

Topical application of an antimicrobial such as povidone iodine.

Chlorhexidine gluconate oral rinse at least twice daily is known to minimize gingival bleeding, erythema and pocket depths.

Systemic metronidazole is a useful adjunct in the management of HIV associated necrotising gingivitis and periodontitis.

Hairy Leukoplakia

Hairy leukoplakia is an adherent white patch usually present on the lateral margins of the tongue. It was generally regarded as

pathognomic of HIV infection, however it is also seen in severely immunocompromised individuals (bone marrow, kidney and liver transplants). Almost 25 % of HIV infected individuals show the presence of hairy leukoplakia. The lesions of hairy leukoplakia have no known pre malignant potential and they are asymptomatic and have a corrugated, shaggy or hairy appearance. Epstein-Barr virus (EBV) has been shown to be present in hairy leukoplakia on the basis of electron microscopy (Figure 2.7).



Figure 2.7

The oral site predilection for hairy leukoplakia probably reflects the presence of EBV receptors on the parakeratinised oral mucosae, such as the lateral margins of the tongue. Other evidence that EBV has a role in causing hairy leukoplakia, is that the lesion regresses with the use of antivirals such as acyclovir and ganciclovir.

Management: Specific treatment is rarely indicated. Antivirals such as ganciclovir, zidovudine and desciclovir can be used. However acyclovir is the most effective drug (1-4 gm per day).

Topical vitamin A is believed to help in the regression of the lesions of hairy leukoplakia.

Kaposi's Sarcoma

Kaposi's sarcoma is the characteristic neoplasm in AIDS. It is an early manifestation of severe HIV disease. It is an endothelial

cell multicentric malignant neoplasm with variable clinical appearance.

Clinical appearance: The clinical appearance of Kaposi's sarcoma is variable, but oral Kaposi's sarcoma typically presents on the palate or sometimes on the tongue or gingiva. It appears as red, bluish or purple patches or nodules and sometimes associated with ulcerations. Initial lesions are macular which later become nodular. Kaposi's sarcoma also presents as cervical lymph node enlargement or may occur in the salivary glands bluish red.

Management: Most patients complain of pain or dysphagia. Intraoral lesions can be treated with radiotherapy (800 to 1500 cGy or equivalent fractionated therapy for 10 days).

- Intralesional injections of vinblastine and interferon-alfa.
- Laser excision of the lesion.
- Zidovudine can be used to manage the underlying HIV infection.

Side Effects of Antiretroviral Drug Therapy

1. Non-nucleoside analog reverse transcriptase inhibitors (NNRTI) for example, efavirenz – cause exudative erythema multiformae, multiple oral ulcers, xerostomia and melanotic hyperpigmentations on the gingiva.
2. Indinavir, Nelfinavir and Ritonavir can cause xerostomia
3. Protease inhibitors can cause parotid lipomatosis and alterations in taste sensation.
4. Ritonavir and Amprenavir can produce peri oral paresthesia

Less Common Oral Manifestations in HIV Infected Individuals

Aphthous Like Ulcerations

The ulcerations that are seen in HIV infected individuals resembles the major form of aphthous ulcers. These may be first seen during the acute illness associated with HIV seroconversion and is generally associated with pharyngeal and oesophageal ulcers.

Management: Topical corticosteroids can be tried. But in cases where the ulcers are resistant to topical steroids, systemic steroids can be administered (40 to 60 mg per day).

Salivary Gland Disease

During the initial phases of the infection patients complain of xerostomia and parotid gland enlargement. It is seen that parotid and submandibular salivary flow rates are diminished in HIV infected individuals. Benign lymphoepithelial lesions may be evident in the biopsy specimens of major salivary glands. Rarely cystic salivary gland lesions may develop.

Management: Xerostomia can be managed with Bethanecol in the doses of 25 mg three times a day, upto 50 mg four times a day. Zidovudine can be used in the management of salivary gland enlargement.

Odontogenic Infections

It has been noticed that odontogenic infections fail to resolve in HIV infected individuals. Sometimes these odontogenic infections may spread through fascial spaces and produce cellulitis. Healing of extraction sockets may be delayed.

Management: Prophylactic antibiotic therapy should be considered while treating HIV infected patients. Odontogenic infections can be managed with high doses of antimicrobials.

Oral Hyperpigmentation

HIV infected individuals show the presence of brownish or brown-black macular hyperpigmentation. The cause is unknown but the identified causes are the use of zidovudine, clofazimine and ketoconazole (Figure 2.8).

Oral Purpura

Spontaneous gingival hemorrhages, petechiae and ecchymoses are common in HIV infected patients. These features are presumably due to thrombocytopenia.



Figure 2.8

Management: Pre operative platelet transfusions and corticosteroids are indicated in some patients.

Neuropathies

Facial nerve palsy resembling Bell's palsy is sometimes seen in patients with HIV infection. Neuropathies typically cause pain and resolve on their own. Though many of the cranial nerves are affected, cranial nerves VIII and V are chiefly affected and may cause facial sensory deficit. Trigeminal neuralgia has also been reported in HIV infected individuals.

HIV Related Embryopathy

Neonates affected with HIV have shown multiple perioral anomalies such as prominent vermillion border of the upper lip, triangular philtrum, hypertelorism, box-like fore head, flattened nasal bridge and slanting eyes.

Protocol for Dental Management of HIV Positive Individuals (For both asymptomatic and symptomatic individuals)

1. An annual routine dental check up
2. Oral prophylaxis (plaque control, supra/subgingival scaling) every 6-12 months
3. Annual radiographic assessment

4. Institute an appropriate treatment schedule based on the patient's requirements
 - a. Identify, diagnose and manage fungal, bacterial, viral and other oral lesions (biopsy may be taken if considered appropriate)
 - b. *Manage xerostomia*: Patients should be instructed to avoid tobacco and alcohol, greater liquid intake is recommended, xylitol chewing gum can be prescribed to stimulate salivation.
 - c. Cellulitis and Osteomyelitis can be treated with Penicillin V 2g per day for 5 to 10 days + metronidazole 400 mg at 8 hour intervals
 - d. *Periodontal treatment*: scaling, root planning, periodontal surgery if indicated. (Irrigate with 0.1% chlorhexidine gluconate). Complex periodontal surgeries (bone regenerative procedures) can be postponed in individuals with CD4 count less than 200.
 - e. *Conservative and Endodontic treatment*: Regular fluoride applications, caries removal and restoration. Asymptomatic and symptomatic peri-apical lesions should be treated with endodontic treatment and peri apical surgery (if indicated).
 - f. *Prosthodontic treatment*: Complex prosthodontic rehabilitation (fixed denture prosthesis, implants) can be planned in individuals with CD4 count greater than 200. Simple prosthodontic work such as removable partial dentures or complete dentures can be planned for patients with CD4 count less than 200. Patients can be instructed to clean their removable dentures with 0.1% chlorhexidine gluconate or with 1 part Benzal chloride in 7.5 parts of water+antiseptic soap+1% hypochlorite.
 - g. *Oral Surgical procedures*: Assess the risk of septicemia (institute antibiotic prophylaxis if appropriate). Estimate the hemostasis status (in the event of history of thrombocytopenic purpura or hepatic problems postpone the surgery). Estimate CD4, CD8 counts, platelet and red blood cell counts.

Surgical extraction of teeth can be undertaken to eliminate septic foci such as abscesses.

- h. *Psychologist, Psychiatrist, Neurologist consultation:* If patients present with episodes of depression, anxiety or neuropathies they should be referred to the concerned specialist for necessary management.

Guidelines for Managing Accidental Exposure to Infective Material

1. Wash the site of exposure/wound with adequate antiseptic soap and water.
2. The area should be pressed firmly to increase the amount of bleeding
3. Record the time, date and describe the mode of exposure
4. Mention the clinical status of the patient (whether infected with HIV, Hepatitis B, Hepatitis C)
5. Consult the nearest hospital dealing with infectious diseases, preferably within 2 hours from the time of exposure. The need for post exposure prophylaxis with antiretroviral drugs will be assessed by the hospital.



Evaluation of Gingival and Periodontal Diseases

The periodontium is a connective tissue organ that is covered by epithelium that attaches the teeth to the jaw bones and provides a continually adapting apparatus for support of teeth during function. Periodontium consists of four tissues two of which are mineralized (Cementum and Alveolar bone) and the other two are soft tissues (Gingiva and Periodontal Ligament).

Periodontal ligament is a fibrous connective tissue that is vascular and cellular. The periodontal ligament occupies the periodontal space, which is located between the cementum and periodontal surface of the alveolar bone. The primary function of the periodontal ligament is to support the tooth in the socket. The average width of the periodontal ligament varies from 0.15 mm to 0.38 mm. The width of the ligament is the smallest at the middle third of the root as this region acts as the fulcrum for physiologic movements of the tooth.

Alveolar bone is that part of the maxilla and mandible that forms the socket and supports the teeth.

Cementum is the mineralized tissue that covers the anatomic roots of teeth. It extends from the cervical portion of the tooth at the cemento-enamel junction and extends right up to the apex of the tooth. It resembles compact bone in all aspects but is avascular.

GINGIVA

It is that part of the oral mucosa that covers the alveolar processes of the jaws and surrounds the necks of the teeth in health.

Anatomical Parts of the Gingiva (Figures 3.1A and B)

Marginal Gingiva or Free gingiva
Interdental Gingiva or interdental papilla
Attached Gingiva

Clinical Examination of Gingiva

Gingiva must be dried before any clinical examination. Moist gingiva can obscure detail when light is reflected by it. Apart from visual examination, and use of probes, palpation should be routinely employed to detect pathologic alterations in consistency and to localize areas of suppuration.

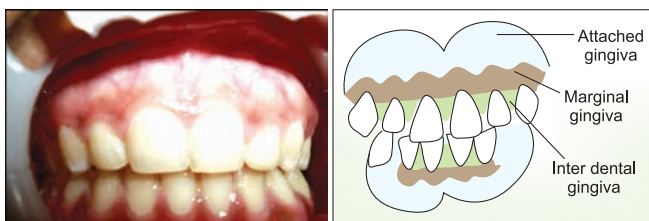
Each of the following features of gingiva should be considered: color, size, contour, consistency, surface texture, position, ease of bleeding and pain.

Color

The color of healthy gingiva is coral pink which depends on the degree of vascularity, thickness of the overlying epithelium, degree of keratinization and the concentration of melanin pigmentation.

Changes in Color

- i. *Physiologic causes*: Melanin pigmentation causes deep purplish, or brownish black color in individuals with a dark complexion (Figure 3.2).
- ii. *Acute Gingivitis*: Bright red erythematous areas, which could be marginal (ANUG), diffuse (Herpetic Gingivostomatitis) or patch like (chemical irritation).
- iii. *Chronic Gingivitis*: red or bluish red color, which is caused by vascular proliferation and reduction of keratinisation owing to epithelial compression by inflamed tissue. Bluish hue is imparted as a result of venous stasis.
- iv. *Metallic Pigmentation*: (absorbed systemically from environmental pollutants or medications)
 - a. Silver (Argyria) – produces a violet colored line on the marginal gingiva



Figures 3.1A and B



Figure 3.2

- b. Lead (Plumbism) – Bluish red or deep blue linear pigmentation of the gingival margin (Burtonian line)
- c. Bismuth, Arsenic and Mercury – black line along the gingival margin.
- v. *Systemic Factors*: Addison's disease, Peutz–Jegher's syndrome, Albright's syndrome, von Recklinghausen's disease (neurofibromatosis) are diseases that cause increased melanin pigmentation leading to altered gingival color.
- vi. *Other causes*: Exogenous factors like coal, metal dust and coloring agents in food can cause change in color of gingiva. Tobacco causes a gray hyperkeratosis of the gingiva. Amalgam Tattoo (local embedding of amalgam in the mucosa) can cause localized bluish black areas.

Size

The size of gingiva refers to the *sum total of the cellular and intercellular components and their vascularity*. Gingival enlargement (increase in size) is a common feature of gingival disease.

Causes for Gingival Enlargement

Inflammatory Causes

- i. *Acute inflammatory enlargement*: gingival abscess, periodontal abscess (generally produces enlargement of gingiva).
- ii. *Chronic inflammatory enlargement*: prolonged exposure to plaque and calculus (poor oral hygiene, ill fitting dentures, overhanging restorations, poorly contoured restorations and crowns, orthodontic appliances) and mouth breathing (red and edematous facial gingiva especially of the maxillary anterior region, possibly caused by surface dehydration).

Fibrotic Enlargement

- i. *Drug induced*: The drugs that produce a non-inflammatory gingival enlargement are Phenytoin, Cyclosporine and Nifedipine.
 - a. *Phenytoin (Dilantin, anticonvulsant, antiepileptic)*: Commonly seen in young patients. Painless, bead-like enlargement of the facial and lingual marginal and interdental gingiva of the mandibular and maxillary anterior regions. Usually pale pink, resilient and has no tendency to bleed.
 - b. *Cyclosporine (immunosuppressive agent used to prevent organ transplant rejection)* Similar to that of phenytoin induced enlargement. Common site is the anterior facial regions of the gingiva. The enlargement usually begins in the interdental regions. Gingiva is pale, resilient, granular and has minimal tendency to bleed.
 - c. *Nifedipine (calcium channel blocker)* Similar to that of phenytoin induced enlargement

- ii. *Idiopathic Gingival enlargement* (Also referred to as hereditary gingival fibromatosis, hereditary gingival hyperplasia, gingivomatosis, diffuse fibroma and elephantiasis gingivae) The condition is rare and has an unknown etiology. The enlargement affects the marginal, interdental and attached gingiva. Gingiva is pink, firm, leathery in consistency and has a minutely pebbled surface.

Combined Gingival Enlargement

Gingival hyperplasia complicated by secondary inflammatory changes results in a combined enlargement.

Gingival hyperplasia interferes with effective oral cleansing methods thereby producing conditions favorable for plaque and calculus accumulation. The secondary inflammatory changes increase the size of the existing gingival hyperplasia producing combined gingival enlargement.

Enlargement Associated with Systemic Diseases and Conditions

- i. *Systemic disease*
 - a. *Leukemia* – Enlargement in Leukemia may be localized, generalized, marginal or diffuse. The gingiva may either show a diffuse enlargement or a tumor like mass. The gingiva is generally bluish red and has a shiny surface. The gingiva is moderately firm, friable and has a tendency towards hemorrhage.
 - b. *Wegner's Granulomatosis* – Interdental gingiva is enlarged, reddish purple in color and bleeds easily on palpation.
 - c. *Sarcoidosis*- Usually seen in the second –third decade of life. Red and smooth gingival enlargement is seen.
- ii. *Conditioned enlargement*
 - a. *Pregnancy*- The enlargement can be marginal and generalized or may occur as a solitary tumor like mass or as multiple masses. The enlargement is more prominent

in the inter proximal areas. The enlarged gingiva is bright red to magenta in color. The gingiva is soft and friable which bleeds spontaneously or on minimal palpation. The tumor like mass seen in pregnancy is referred to as *Pregnancy tumor or Angiogranuloma*. The lesion is usually discrete, spherical and usually arises from the interdental areas. It could either be sessile or pedunculated. It is generally dusky red to magenta in color. It has a smooth glistening surface with multiple pinpoint red markings. It is painless and varies in consistency from firm to soft and is friable.

- b. *Puberty* – Seen in adolescent girls and boys. Marginal and interdental gingiva is bulbous. Generally the facial gingiva is enlarged and the lingual gingiva is practically unaltered.
- c. *Vitamin C deficiency* – The marginal gingiva is enlarged, bluish red, soft and friable and has a smooth shiny appearance. Gingiva bleeds spontaneously or on slight provocation. Surface necrosis with pseudo membrane formation is a common feature.
- d. *Plasma cell gingivitis (atypical gingivitis)*- marginal gingiva is enlarged. Very rarely the enlargement extends to the attached gingiva. Gingiva appears red and granular. It is friable and has a tendency to bleed.
- e. *Granuloma pyogenicum (nonspecific conditioned enlargement)*- tumor like gingival enlargement, which is thought to be an exaggerated response to minor trauma. The lesion is usually seen as a discrete spherical tumor like mass with a pedunculated attachment or a flat base. It is bright red or purple in color. In majority of the cases it presents with a surface ulceration or purulent exudation.

Neoplastic Enlargements

- i. *Benign tumors of the gingiva*- Fibroma, Papilloma, Peripheral giant cell granuloma, Central giant cell granuloma, Gingival cysts.

- ii. *Malignant tumors of the gingiva*- Carcinoma, Malignant melanoma, Sarcoma, tumor metastasis to the gingiva.

False Enlargements

They are not true enlargements of gingiva but may appear as such as a result of increase in the size of the underlying dental tissues or osseous structures.

Osseous structures – tori, exostoses, cherubism, Paget's disease, ameloblastoma, osteoma, osteosarcoma.

Dental tissues- during various stages of eruption of teeth gingiva may show marginal bulbous distortion.

Contour: Healthy gingiva is scalloped and knife edged. In gingivitis the marginal gingiva loses the scalloped margins and the gingival edge becomes blunt (Figure 3.3).



Figure 3.3

Consistency: The consistency of gingiva is firm and resilient. The gingival fibers contribute to the firmness of the gingival margin. In chronic inflammatory condition gingiva becomes edematous and sometimes fibrotic. Where as in acute conditions gingiva is soft and edematous.

Surface texture: The attached gingiva and the central portion of the interdental papilla show stippling. The texture appears like that of an *Orange peel*. Stippling is best examined by drying the gingiva. Reduction or loss of stippling signifies gingival disease.

Bleeding: The severity of the bleeding and the ease with which it is provoked depend on the intensity of inflammation. Healthy gingiva does not bleed.

Bleeding from the gingiva can clinically be classified as

- A. Spontaneous gingival bleeding
- B. Bleeding on palpation
- C. Bleeding on probing

However, apart from the local factors leading to bleeding there could be gingival bleeding associated with systemic disturbances. Bleeding is encountered in vascular abnormalities such as vitamin C deficiency or Schönlein-Henoch purpura, platelet disorder, coagulation defects like hemophilia, leukemia, Christmas disease and multiple myeloma. Bleeding may also result from large doses of drugs like salicylates, anticoagulants like dicumarol and heparin.

Examination

Spontaneous Gingival Bleeding

Patients will generally complain of presence of blood in sputum when they rinse their mouths especially after waking up in the morning.

On examination blood tinged saliva can be seen on the cervical margins and facial surfaces of teeth. It can also be seen in the vestibules and floor of the mouth (as saliva tends to pool in these regions).

Management: Rule out underlying bleeding disorders (complete blood picture).

Reassure the patient that the amount of blood lost is minimal but seems to be excessive as the saliva is tinged with blood.

Evaluate for gingival or periodontal disease and appropriate treatment plan should be formulated.

Bleeding on Palpation

Patient will generally give a history of bleeding from the gums while chewing food

Mild palpation with a gloved finger will induce gingival bleeding. Bleeding on palpation is usually a clear sign of relatively severe form of gingival and periodontal disease.

Bleeding on Probing

Usually asymptomatic and occasionally patients may report of bleeding from the gums during brushing teeth.

Examination for bleeding on probing is carried out using a blunt ended periodontal probe. The technique is referred to as “walking the probe” (Figure 3.4).

This technique is also used to examine for periodontal pockets.

The periodontal probe is gently moved within the gingival sulcus usually beginning from the upper third molar and going across the arch to the other side and similarly in the lower arch. Once probing is completed in one arch gingival sulcus is examined for bleeding. The sites that bleed are recorded.

Calculus

It is an adherent calcified or calcifying mass that forms on the surface of natural teeth and dental prosthesis.

According to the location calculus can be classified as Supragingival or Subgingival

Supragingival calculus (also called salivary calculus) is located coronal to the gingival margin.

It is most frequently seen on the buccal surfaces of maxillary molar teeth and lingual surfaces of mandibular anterior teeth as the Stenons and Wharton's duct respectively open in these regions (Figure 3.5).

Subgingival calculus (also called serumal calculus) is located below the crest of the marginal gingiva.

Clinical grading of Calculus (Simplified Oral Hygiene Index)

Score 0 – No calculus present

Score 1- Supragingival calculus covering not more than 1/3rd of the exposed tooth surface



Figure 3.4



Figure 3.5: Calculus on lingual surface of anterior teeth

Score 2- Supragingival calculus covering more than 1/3rd but not more than 2/3rd of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both.

Score 3- Supragingival calculus covering more than 2/3rd of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both.

PERIODONTAL POCKET

Definition

It is the pathological deepening of the gingival sulcus.

Types of periodontal pockets

True periodontal pocket: this type of pocket occurs as a result of destruction of the supporting periodontal tissues.

Pseudo/False periodontal pocket: pocket formed as result of gingival enlargement without the destruction of the periodontal tissues.

Periodontal pockets can be assessed by gently walking a blunt ended probe (periodontal probe) within the gingival sulcus (Figures 3.6A and B).

Clinical features which suggest the presence of a true periodontal pocket

Thickened marginal gingiva

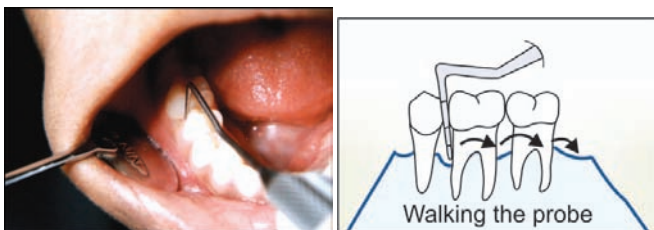


Figure 3.6: Walking the probe

Bluish red vertical zone from the margin of the gingiva to the alveolar mucosa

Tooth mobility

Pus discharge from the gingival sulcus

Localized pain

Probing reveals deepening of the gingival sulcus

GINGIVAL RECESSION

Apical migration of the gingival margin resulting in exposure of the root surface is referred to as gingival recession (Figure 3.7).

Clinically when recession is noticed in the oral cavity, the following need to be examined

1. Presence of local factors (calculus on the cervical margin of the tooth)
2. Ask the patient to demonstrate the brushing techniques he/she employs (faulty brushing can cause gingival recession)
3. Malpositioned teeth
4. High frenal attachment
5. Soft tissue friction (ablation)

Passing a probe over the exposed tooth surface might be highly sensitive to the patient.

MOBILITY

Clinical evaluation of mobility: The first step towards checking for mobility should be in differentiating between physiologic



Figure 3.7

mobility and pathologic mobility. It is a known fact that all teeth have a slight degree of physiologic mobility. It is greatest for single rooted teeth. Physiologic mobility is seen in the late stages of deciduous dentition, which is associated with preshedding movement. However, pathologic mobility is associated with weakened periodontal condition or an underlying pathology of the bone. Tooth mobility is associated with limited occlusal contact, trauma (micro/macro), pregnancy, menstrual cycle, contraceptive pills and periodontal surgeries.

To check for mobility it is always advisable to use handles of slender instruments like the mouth mirror or straight probe rather than use fingertips as this may obscure any subtle movement. Using the back ends of two mouth mirrors or probes alternating pressure can be applied on the buccal and lingual surfaces of the tooth to check for mobility (Figure 3.8). The tooth should also be checked for any apical movement. Alternatively, fremitus test can be employed to check for minimal mobility of teeth caused by traumatic bite. A finger is placed on the facial aspect of the tooth and the patient is instructed to clench his teeth. A dull vibrational sensation and mobility can be perceived in this manner.



Figure 3.8

Miller's classification of tooth mobility

Grade 0: Physiologic mobility

Grade 1: Movement of the tooth in a faciolingual direction

Grade 2: Faciolingual and mesiodistal movement of the tooth

Grade 3: Movement of the tooth in apical direction (tooth can be depressed back into the socket)

EXAMINATION PROTOCOL FOR DISEASES AFFECTING THE PERIODONTIUM

History (ask for duration, aggravating and relieving factors)

Do your gums bleed? (on brushing, all the time, while chewing; rule out systemic causes for bleeding)

Do you have foul breath? (rule out underlying systemic causes)

Do your teeth shake? (rule out h/o trauma, microtrauma from traumatic bite)

Does your food get lodged between teeth/in the gums?

Do you have sensitivity on consuming hot and cold food?

Do you have a salty taste in your mouth?

Do you use toothpicks?

Are you presently on any medication for any systemic problem?

Are you Diabetic, Hypertensive Epileptic or suffering from bleeding disorders?

Are you pregnant?

Do other members of the family have similar problems?

Examination

Evaluate for halitosis

Make a note of local deposits (calculus, stains and materia alba)

Examine all the three parts of the gingiva (marginal, interdental and attached)

Make a mention of change in color, contour, surface texture, and consistency.

Evaluate for bleeding on probing.

Make a note of any enlargement of the gingiva.

Record all the sites where there is root surface exposure (gingival recession).

Probe gingival sulcus to screen for periodontal pockets.

Check for mobility of teeth (rule out traumatic bite, trauma).

Mention sites of pathologic migration of teeth.

Palpate gingiva to evaluate for tenderness and pus discharge from the gingival sulcus.

Mention presence of abscess (make a note of the size, location, discharge, tender/nontender).

Note: Plaque is not readily seen but can be visualised by using disclosing agents.

Clinical Features of Acute Gingivitis

1. Intense erythema of the gingiva
2. Spontaneous gingival bleeding or bleeding from the gums on minimal palpation
3. Generalised “soreness” of the oral cavity leading to difficulty in eating and drinking
4. Multiple punched out ulcers involving the interdental and marginal gingiva (Acute Necrotising Ulcerative Gingivitis)
5. Diffuse, erythematous, shiny gingiva, soft and oedematous, with multiple grey vesicles (Primary Herpetic Gingivostomatitis)
6. Increased salivation and fetid odour
7. Slight increase in body temperature
8. Regional lymphadenopathy

Clinical Features of Chronic Gingivitis

1. Asymptomatic
2. Extensive local factors of plaque and calculus
3. Marginal and interdental gingiva appears bluish red
4. On palpation gingiva is soft and oedematous and some cases fibrotic
5. Bleeding on probing or spontaneous gingival bleeding
6. Gingival enlargement
7. Loss of stippling and contour, gingival margin is blunt and rounded.

Clinical Features of Chronic Periodontitis

1. Generally asymptomatic
2. Halitosis
3. Supra/sub gingival calculus
4. Mobility of teeth
5. Periodontal pocket formation
6. Gingival recession
7. Marginal and interdental gingival is soft and oedematous
8. Pus discharge from the gingival sulcus
9. Radiographs reveal interdental bone loss (horizontal or vertical)

Clinical Features of Juvenile Periodontitis

1. Seen during puberty and within 20 years of age.
2. Generally incisors and first molars are affected
3. Very minimal amount of local factors (plaque, calculus)
4. Mobility and pathologic migration of incisors and molars
5. Dull radiating pain which occurs during mastication (food irritates supporting structures)
6. Radiographic features include angular bone loss with respect to incisors and first molars and arc shaped loss of alveolar bone extending from the distal surface of the second premolar to the mesial surface of second molar.

Clinical Features of Pre-pubertal Periodontitis

1. Commonly seen in children below the age of 11 years
2. Generally seen affecting the deciduous and mixed dentition.

3. Associated with underlying systemic disorders like Papillon le Fevre syndrome, Down syndrome and Neutropenia
4. Extensive destruction of bone both in the anterior and posterior teeth

Clinical Features of Rapidly Progressive Periodontitis or Aggressive Periodontitis (Figure 3.9)

1. Commonly seen in the age group of the 18 to 30 year olds
2. Gingiva on examination generally appears very healthy with no signs of inflammation, however on probing deep periodontal pockets are present
3. Teeth with furcation (multi-rooted teeth) generally show more destruction of the periodontium
4. Radiographs reveal interdental horizontal and angular bone loss.

Note: Patient needs to be screened over a period of time for assessing the rapidity of the disease process. Hence, a diagnosis of rapidly progressive periodontitis cannot be made during the first appointment with the oral physician.

Gingival and Periodontal Abscess (Figure 3.10)

	Gingival abscess	Periodontal abscess
Aetiology	Embedding of foreign objects into the gingiva (tooth brush bristles, food fragments)	Remnants of calculus left behind after subgingival scaling or Spread of infection from the periodontal pocket to supporting tissues
Location	Confined to marginal gingiva or interdental papilla	Usually seen involving both the marginal and interdental papilla
Pocket	Can occur in the absence of a pocket	Periodontal pocket is invariably present

Contd...



Figure 3.9



Figure 3.10

Contd...

	Gingival abscess	Periodontal abscess
Mobility	Can occur in the absence of tooth mobility	The tooth is generally mobile
Pus discharge from the gingival sulcus	Generally absent	Usually present
Radio-graphic findings	None	Horizontal or angular interdental bone loss



Evaluation of Pulp and Periapical Diseases

Dental caries is considered as one of the most common infectious diseases affecting the human race which is also the commonest cause for pulpal inflammation.

A common source of infection of the jaws is inflammatory disease of the pulp. Other causes include infections from the periodontal ligament, wasting diseases (attrition, abrasion, erosion), extraction wounds, compound fractures and rarely from hematogenous infection.

Dental caries is defined as a microbial disease of the calcified tissues of the teeth characterized by demineralization of the inorganic portion and destruction of the organic structure of the tooth.

CLINICAL CLASSIFICATION OF DENTAL CARIES

1. Depending on the location on the individual tooth:
 - A. Type
 - Pit and fissure caries
 - Smooth surface caries
 - B. Site involved
 - Occlusal caries
 - Proximal caries
 - Facial, buccal and lingual caries
 - Root surface caries.
2. Depending on the rapidity of the process
 - A. Duration
 - Acute dental caries
 - Chronic dental caries

- B. Progression
 - Incipient lesions
 - Moderate lesions
 - Severe lesions
- 3. Depending on whether the lesion is a new one or attacking a previously carious surface
 - Primary caries (virgin)
 - Recurrent caries (secondary)
- 4. Other form of dental caries
 - Rampant caries
 - Nursing bottle caries
 - Radiation caries

CLINICAL EXAMINATION OF THE CARIES LESION

Dental caries is diagnosed by the following

- Visual examination—tooth surface texture or color
- Tactile examination—with an explorer which is used judiciously
- Transillumination
- Radiographs

Other newer techniques include electrical conductance and laser fluorescence tests.

Clinical Features

Patient's age, dental history, oral hygiene and diet may suggest a clinical pattern of caries activity and susceptibility.

Dental caries usually tend to occur bilaterally and on adjacent proximal surfaces. If caries is found on the occlusal surface and a proximal surface in one tooth on one side of the arch, then chances are increased that it will occur in the same locations on the opposite side. If caries is found on the proximal surface of one tooth, then the adjacent tooth's proximal surfaces may also be involved. In the clinical examination for dental caries every assessable surface of each tooth must be examined for localized changes in color, texture, and translucency.

Caries is most prevalent in the faulty pits and fissures of the occlusal surfaces, where developmental lobes of the posterior teeth fail to coalesce, partially or completely. Fissures and pits are detected visually.

Earlier sharp explorers were used to detect the fissure caries. However in recent times it is strongly discouraged as it was found to fracture enamel and serve as a source for transferring pathogenic bacteria among various teeth. It was also noted that the use of an explorer did not increase diagnostic validity compared to visual examination.

The occlusal surface is examined visually. It is conducted in a dry, well-illuminated field. Through direct vision or reflecting light, the occlusal surface is diagnosed as diseased if there is chalkiness or apparent softening, cavitation of the tooth structure forming the fissure or pit or brown gray discoloration radiating peripherally from the fissure or a pit. Care should be taken to distinguish between the superficial staining and the carious lesion.

Precarious or carious pits are occasionally present on cusp tips. Carious pits and fissures also occur on the occlusal two thirds of the facial or lingual surface of the posterior teeth and on the lingual surface of maxillary incisors. Occlusal enamel can be evaluated for loss of translucency and change in color, which are characteristics of caries. Care should be taken to rule out extrinsic stains.

Proximal surface caries is usually diagnosed radiographically. Clinically when caries have invaded the proximal surface enamel and dentin, a white chalky appearance or a shadow under the marginal ridge may be seen. Careful probing with an explorer on the proximal surface may detect cavitation, which is defined as a break in the surface contour of enamel. Proximal caries can also be detected by tooth separation or through transillumination. Brown spots on intact hard proximal surface enamel adjacent to and usually gingival to the contact area are often seen in older patients whose caries activity is low. Such a spot is no longer carious and in fact are more resistant to

caries as a result of fluorhydroxyapatite formation. Restorative treatment is not indicated for such lesions. Visual inspection, probing, and transillumination may identify proximal surface caries in anterior teeth. Transillumination is accomplished by placing the mirror or light source on the lingual side of the anterior teeth and directing the light through the teeth.

Another form of smooth surface caries often occurs on the facial and lingual surfaces of the teeth, particularly in the surfaces covered by gingiva that are less accessible for cleaning. The earliest clinical evidence of incipient caries on these surfaces is a white spot that is visually different from the adjacent translucent enamel and will partially or totally disappear on wetting. Drying again will cause it to reappear. This disappearing/reappearing phenomenon distinguishes the smooth incipient caries from the white spots resulting from nonhereditary enamel hypocalcification.

In patients with periodontal pockets, care must be taken to inspect for root surface caries. Carious lesion occurs on the cemental surfaces of the teeth. Active root caries is detected by the presence of softening and cavitation.

The presence of several facial or lingual smooth surface carious lesions within the patient's dentition suggests a high caries rate. In a caries susceptible patient the gingival third of the facial surfaces of maxillary posterior teeth and the gingival third of the facial and lingual surfaces of the mandibular posterior teeth should be evaluated carefully because these teeth are at a greater risk for caries. Advanced smooth surface caries will exhibit discoloration and demineralization and will feel soft to penetration by the explorer. The discoloration may range from white to dark brown, with rapidly progressive caries usually being light in color. With slowly progressive caries in a patient with low caries activity, darkening occurs over time because of extrinsic staining and remineralization of decalcified structure occasionally may harden the lesion. Such an arrested lesion may at times be rough, although cleanable and a restoration is

not indicated except for esthetic reasons. The dentin in an arrested remineralized lesion is termed eburnated or sclerotic dentine.

Regardless of the location or type of carious lesions, a careful, thorough clinical examination is critical in the diagnosis of caries and for confirmation of radiographic evidence of the disease.

SEQUELAE OF DENTAL CARIES

The initial lesion may appear as an opaque white or brown spot beneath the plaque layer. As the carious lesion advances it invades, involves pulp the dentin and then involves the pulp.

Depending on the condition of the associated tooth/ teeth, the infectious products from the diseased pulp may be released from the tooth into the oral cavity or to the periapex. If the infected tooth continues to drain into the oral cavity it will remain asymptomatic and cause no detectable pathologic response. If however the infectious agents or their degradation products from the infected pulp reach the periapical connective tissue, the reaction they elicit will depend on their nature and amount and the resistance of the host.

Enamel Caries: (Figure 4.1)

Chief complaint: Food lodgment, decayed tooth, occasional sensitivity.

On examination: Discoloration, cavity formation, may not be deep enough for probing depth. Caries lesions of the proximal surfaces of teeth show fraying of the dental floss.

Clinical diagnosis: Enamel caries

Radiographic finding: Diffuse radiolucency involving enamel (need not necessarily be shown on all radiographs as a minimum of 40% demineralization is required to be evident on a radiograph).

Treatment plan: Restoration.

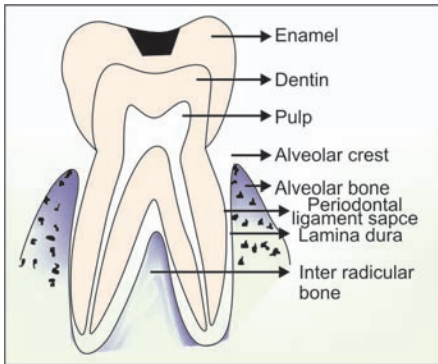


Figure 4.1

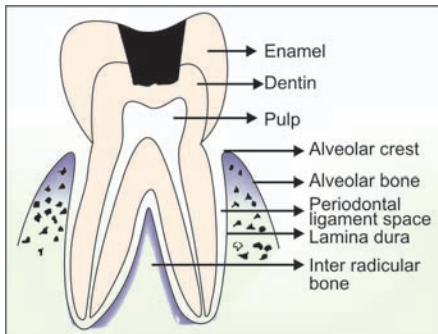


Figure 4.2

Dental Caries (Figure 4.2)

Chief complaint: Food lodgment, decayed tooth, sensitivity for heat/cold *only* on stimulus.

On examination: Discoloration, cavity formation, may be sensitive to probing. *Non tender* on vertical percussion. Carious lesions of the proximal surfaces of teeth show fraying of the dental floss.

Clinical diagnosis: Dental caries

Radiographic finding: Diffuse radiolucency involving dentin.

Treatment plan: Restoration.

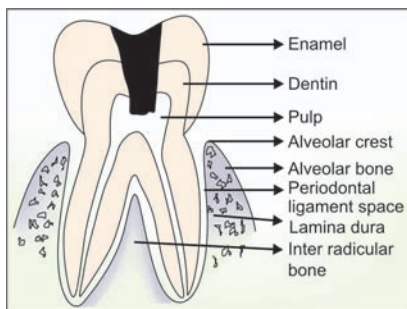


Figure 4.3

Irreversible Pulpitis (Figure 4.3)

Chief complaint: Continuous pain, severity of pain depends on duration or due to exacerbation of chronic lesion. Pain may be described as lancinating, throbbing or pricking. Pain increases on lying down.

On examination: Deep cavity formation, may show pulpal involvement

The offending tooth will be non-tender on vertical percussion.

Clinical diagnosis: Acute/Acute exacerbation of chronic/ chronic irreversible pulpitis.

Radiographic finding: Diffuse radiolucency involving pulp.

Treatment plan: Root canal therapy.

Apical Periodontitis (Figure 4.4)

Chief complaint: Similar to irreversible pulpitis.

On examination: Similar to irreversible pulpitis with one additional finding, i.e. tooth will be tender on vertical percussion.

Clinical diagnosis: Acute/acute exacerbation of chronic/chronic apical periodontitis

Radiographic finding: Diffuse radiolucency involving pulp with widening of periodontal ligament space at the periapex

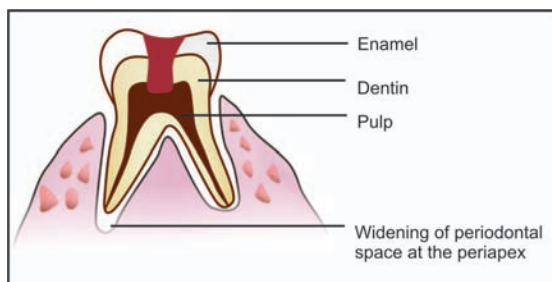


Figure 4.4

Note: Acute apical periodontitis will generally not reveal any periapical radiographic changes. Periapical radiographic changes can be appreciated only in chronic lesions as it requires three to four weeks to appreciate the changes on the radiograph.

Periapical Abscess (Figure 4.5)

Chief complaint: Similar to irreversible pulpitis

On examination: Similar to apical periodontitis with one additional finding, i.e. vestibular tenderness

Radiographic finding: Similar to apical periodontitis with one additional finding, i.e. diffuse periapical radiolucency or discontinuity of lamina dura at the periapical region of the tooth.

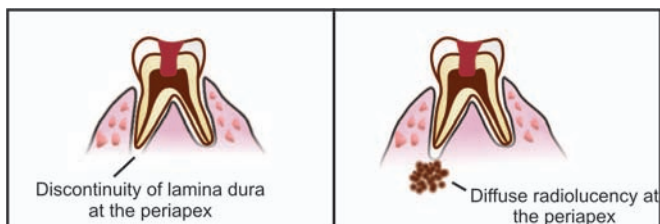


Figure 4.5

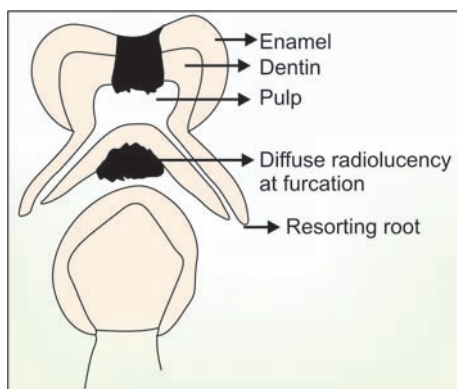


Figure 4.6

Dento-alveolar Abscess

Chief complaint: Similar to irreversible pulpitis with a complaint of extraoral swelling.

On examination: Extraoral swelling. Location depending on the offending tooth.

Intraoral examination is similar to periapical abscess with one additional finding ie vestibular obliteration.

Radiographic finding: similar to periapical abscess.

Furcal Abscess (Figure 4.6)

Commonly seen in deciduous teeth. It is due to infection spreading into the furcation area as the infection spreads to the area of least resistance, via the accessory/lateral canals.

Chief complaint: Similar to irreversible pulpitis

On examination: Dental caries involving pulp, generally swelling is noticed in the attached gingiva, No vestibular obliteration.

Radiographic finding: Diffuse radiolucency in the furcation area. Resorption of the roots.



Figure 4.7

Cellulitis: The only feature that differentiates cellulitis from dento-alveolar abscess is the diffuse extraoral swelling. The swelling involves fascial spaces depending upon the drainage of the offending tooth (e.g: buccal, submandibular, sub-massetric space, etc.) (Figure 4.7).

Table 4.1: Common sites of localisation of acute dental infections

<i>Tooth involved</i>	<i>Usual site of exit of infection from the bone</i>	<i>Relation of muscle attachment to root apices</i>	<i>Site of localisation of the infection</i>
Upper central incisor	Labial	Above	Oral vestibule
Upper lateral incisor	Labial Palatal	Above	Oral vestibule Palate
Upper canine	Labial	Above Below	Oral vestibule Canine space
Upper premolars	Buccal Palatal	Above	Oral vestibule Palate
Upper molars	Buccal Palatal	Above Below	Oral vestibule Buccal space Palate
Lower incisors	Labial	Above Below	Submental Space Oral vestibule

Contd...

Contd...

<i>Tooth involved</i>	<i>Usual site of exit of infection from the bone</i>	<i>Relation of muscle attachment to root apices</i>	<i>Site of localisation of the infection</i>
Lower canine	Labial	Below	Oral vestibule
Lower Premolars	Buccal	Below	Oral vestibule
Lower 1st molar	Buccal	Below	Oral vestibule
	Lingual	Above	Buccal space
Lower 2nd molar	Buccal Lingual	Below	Sublingual space
		Below	Oral vestibule
		Above	Buccal space
		Below	Sublingual space
Lower 3rd molar	Lingual	Above	Submandibular space
		Above	Pterygomandibular space

Ludwigs-angina

Ludwigs-angina is a type of cellulitis, which involves submandibular, sub-lingual, sub-mental spaces, crosses the midline to the other side of the face. The significant clinical finding is the raise of the floor of the mouth (Figure 4.8).

Patient may complain of difficulty in swallowing and severe cases may have difficulty in breathing.



Figure 4.8

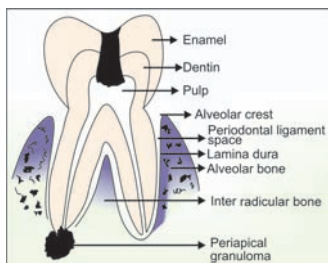


Figure 4.9

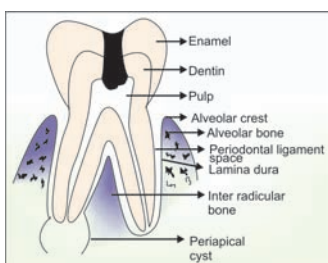


Figure 4.10

Periapical Granuloma (Figure 4.9)

It is a radiographic diagnosis.

Chief complaint: similar to irreversible pulpitis.

On examination: similar to chronic periapical abscess

Radiographic finding: well defined radiolucency at the periapex measuring less than 1.5 centimeters in diameter (It is rarely large enough to cause cortical expansion).

Periapical Cyst

Chief complaint: Similar to chronic irreversible pulpitis, it may show acute signs if it gets infected.

On examination: If the cyst is large enough an intraoral swelling is appreciated. Usually it is firm in consistency with areas of decortication.

Radiographic finding: well defined radiolucency with sclerotic border, which measures more than 1.5 centimeters in diameter (Figure 4.10).

(The sclerotic response is mark of chronicity.)

Note: In order to confirm whether the lesion is a cyst or granuloma histopathological examination has to be carried out. However, the sclerotic border is generally not evident in cysts that are secondary infected.

Osteomyelitis

Osteomyelitis is defined as inflammation of the bone and the bone marrow. Although the osteomyelitis of the jaw is caused

by variety of causes, dental caries is the most common of all. Other causes include radiation, fractures, gunshot wound, and specific infections like tuberculosis, syphilis, actinomycosis and sometimes-fungal infections like blastomycosis and coccidiomycosis and rarely hematogenous spread. Although different organisms are cultured the most commonly isolated organisms are *Staphylococcus aureus* and *Staphylococcus albus* and various streptococci. The disease may be acute, sub acute or chronic and presents a different clinical course depending upon its nature.

Acute Suppurative Osteomyelitis

It is a serious sequelae of periapical infection that often results in spread of infection throughout the medullary spaces, with subsequent necrosis of a variable amount of bone.

Clinical features: Patient may present with elevation of body temperature, difficulty in chewing and severe pain of the involved tooth. There will be no swelling until periostitis develops. Paresthesia or anesthesia of the lip is a common feature.

Intraoral finding may be that of any periapical disease.

Radiographic features: There will be no radiographic evidence until the disease has progressed for at least one to two weeks. By the end of two weeks diffuse lytic changes in the bone will be appreciated. Individual trabeculae become fuzzy and indistinct and radiolucent areas begin to appear.

Treatment: Drainage to be established and antibiotic coverage to prevent further spread and complications.

Chronic Suppurative Osteomyelitis

Chronic suppurative osteomyelitis may develop after the acute phase of the disease has subsided or sometimes as a chronic lesion from its onset. On few occasions the chronic lesion may go into acute exacerbations.

Clinical features: The clinical features are similar to acute osteomyelitis except that all signs and symptoms are milder. In chronic lesions or in acute exacerbated lesions the suppuration may perforate the bone and the overlying skin to form a fistulous tract and drain on the surface (Figure 4.11).



Figure 4.11

Chronic Focal Sclerosing Osteomyelitis (Condensing Osteitis)

Condensing osteitis is an unusual reaction of bone to infection. It occurs when there is extremely high tissue resistance or in cases of low-grade infection. In such instances the tissues react to the infection by proliferation rather than destruction, since the infection acts as a stimulus rather than as an irritant. It is a radiographic diagnosis.

Clinical features: Usually seen in persons below 20 years of age. Mandibular first molar is the most commonly involved tooth. Signs and symptoms will be that of the infected pulp.

Radiographic features: The periapical radiograph shows a well-circumscribed radiopaque mass of sclerotic bone surrounding and extending below the apex of one or both roots. The entire root outline is nearly always visible. This helps in distinguishing it from benign cementoblastoma. The border of this radiopacity, abutting the normal bone may be smooth and distinct or appear to blend into the surrounding bone.

Treatment: The infected tooth is endodontically treated or extracted. The dense bone may get remodelled or sometimes recognized even after years on a radiograph.

Chronic Diffuse Sclerosing Osteomyelitis

Chronic diffuse sclerosing osteomyelitis is similar to the focal type except that the port of entry is periodontal disease and not the carious lesion.

Clinical features: May be seen at any age but most commonly seen in older individuals.

Usually does not present with any clinical indications but sometimes mild suppuration and fistula opening onto the mucosal surface may be seen. In such cases with suppuration patient may present with vague pain and a bad taste in the mouth.

Radiographic features: Chronic diffuse sclerosing osteomyelitis shows diffuse sclerosis of the bone. The radiopaque lesion may be extensive and bilateral. Because of the diffuse nature of the disease the border between the sclerosis and the normal bone is often indistinct. This is described as “cotton wool” appearance and it also resembles Paget’s disease of bone.

Treatment: Conservative treatment. Acute exacerbated lesions may require antibiotic coverage.

Chronic Osteomyelitis with Proliferative Periostitis (Garre’s Osteomyelitis)

Garre described chronic diffuse sclerosing osteomyelitis in 1893 as a focal gross thickening of the periosteum of long bones, with peripheral reactive bone formation resulting from mild irritation or infection. It differs from the other type of osteomyelitis as it is of periosteal osteosclerosis while others represent endosteal osteosclerosis.

Clinical features: Seen in young adults under 25 years of age

Patient may present with toothache or pain in the jaw or of a hard bony swelling on the outer surface of the jaw

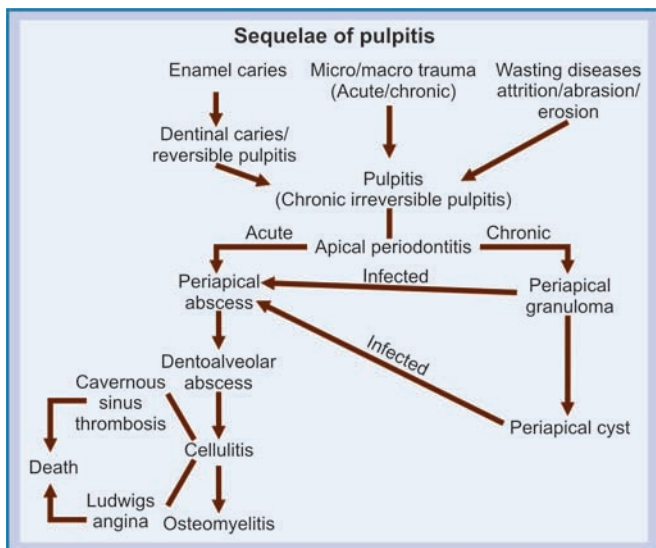
Radiographic features: Radiograph will reveal a carious tooth opposite the hard bony mass.

Occlusal radiograph will show a focal overgrowth of bone on the outer surface of the cortex, which may be described as a duplication of the cortical layer of bone. This mass of bone is smooth and rather well calcified and may itself show a thin but definitive cortical layer. It is also described as an “onion peel” appearance.

Treatment: Chronic osteomyelitis with proliferative periostitis is best treated with endodontic treatment or extraction of the

carious tooth with no surgical intervention for the periosteal lesion except for biopsy to confirm the diagnosis.

Flowchart 4.1: Sequelae of pulpitis





Examination of Ulcers and Swellings of the Orofacial Region

ULCERS OF THE OROFACIAL REGION

An ulcer is defined as a breach in the continuity of the surface epithelium of the skin or mucous membrane to involve the underlying connective tissue as a result of micromolecular cell death of the surface epithelium or its traumatic removal.

Ulcers in the orofacial region can either be symptomatic or asymptomatic. Generally patients will notice the ulcer and seek treatment for the same. However in some instances ulcers may occur in sites, which are not easily noticed, and the patient may only complain of associated symptoms such as pain, fever, or difficulty in swallowing. An important aspect in dealing with oral ulcerations is that any ulcer that does not heal spontaneously or with adequate treatment within 3-4 weeks of its initial occurrence should be planned for a biopsy.

EXAMINATION OF ULCERS IN THE OROFACIAL REGION

History

1. When was the ulcer first noticed?

The duration gives an idea about the character of the ulcer. Usually traumatic ulcers and aphthous ulcers are acute in nature however long standing ulcers (over 3-4 weeks) can be malignant.

2. How did the ulcer begin? (spontaneously, after trauma or following a swelling)

Aphthous ulcers occur spontaneously. Patient who gives a history of cheek bite or of an epileptic seizure resulting in injuring his/her tongue is suggestive of traumatic ulcers. Ulceration arising from a previous blister may indicate a vesiculobullous lesion or arising out of a lump may indicate a malignant ulcer.

3. Do you have ulcers else where in the body?

Multiple ulcers are seen in primary syphilis. Presence of chancre in the oral cavity and genital region. Behcets syndrome is associated with ocular, oral and genital ulcers.

4. Has the ulcer grown in size since first noticed? Has it ever regressed?

Malignant ulcers tend to grow in size. Aphthous ulcers tend to regress spontaneously (generally in 7 to 14 days)

5. Do the ulcers heal spontaneously and do they recur at frequent intervals?

Recurrent aphthous ulcers heal spontaneously and recur at frequent intervals. If the cause for trauma is not eliminated, traumatic ulcers can also exhibit recurrence. Malignant ulcers do not heal spontaneously.

6. Is it associated with pain, fever, foul taste/smell, pus/blood discharge and difficulty in swallowing, eating, and speech? Ulcers associated with necrotising ulcerative gingivitis (NUG), primary herpetic gingivostomatitis and oropharyngeal ulcers associated with infectious mononucleosis may be characterized by the presence of pain and fever. Patient generally has difficulty in eating, swallowing and speech. Ulcers associated with NUG are accompanied by foul taste and breath. Aphthous ulcers and ulcers secondary to trauma are painful. Traumatic ulcers involving blood vessels may cause bleeding from the ulcer. Ulcers in the initial stages of malignancy are generally painless. Malignant ulcers in the oral cavity can cause difficulty in speech, swallowing depending on the location of the ulcer.

7. Do you suffer from any other systemic diseases? Systemic diseases like diabetes, tuberculosis, nephritis and syphilis tend to cause ulcers in the oral cavity.

Ask for use of medications like sulpha drugs, etc. which can cause ulcerations.

8. Have you consulted any other physician for this problem prior to this visit?

If yes, record the nature of treatment advised.

Previous consultations and nature of treatment will be useful to assess the nature of the ulcerative lesion. History of previous treatments is a useful pointer towards the recurrent nature of the ulcer. Results of previous laboratory investigations can be helpful to evaluate the systemic condition of the patient.

Examination

Inspection

Site/location of the ulcer:

Aphthous ulcers are generally seen on the non-keratinized areas of the oral mucosa such as the lips, buccal mucosa and soft palate (Figure 5.1).

Traumatic ulcers will usually be present beside the

traumatic agent such as a sharp tooth, sharp edge of a denture. Ulcers of necrotising ulcerative gingivitis are characteristically seen as punched out lesions on the interdental regions of the gingiva. Syphilitic ulcers occur at the site of inoculation of the organism such as the oral and genital regions.

Size and shape of the ulcer: Malignant ulcers have an irregular shape. Recurrent aphthous ulcers are small and round with an erythematous halo around the periphery of the ulcer. Ulcers of syphilis are circular or semicircular in shape however over a period of time the ulcers tend to develop wavy margins (serpigenous). Tuberculous ulcers are oval in shape. Traumatic ulcers tend to conform to the shape of the offending agent causing trauma (sharp cusp of a tooth, irregular sharp margins of a denture).



Figure 5.1

Solitary/multiple ulcers: Traumatic ulcers and malignant ulcers generally occur as single ulcers. Ulcers associated with NUG, vesiculobullous lesions, primary herpetic gingivostomatitis, tuberculosis, syphilis and recurrent aphthous stomatitis tend to be multiple in number.

Edge of the ulcer (Figure 5.2): Ulcers occurring in the orofacial region can present with the following edges.

- a. *Sloping edge:* Ulcers with sloping edges indicate a healing ulcer. Removal of the offending agent in a traumatic ulcer will generally show a sloping edge during the period of regression.
- b. *Punched out edge:* In relation to the surface of the ulcer, the edge of the ulcer is at right angles. Punched out edge is a characteristic finding in gummatous ulcers. Ulcers associated with NUG show punched out edges.
- c. *Undermined edge:* Undermined edge is produced as a result of destruction of the submucosal or subcutaneous tissue at a rate faster than the destruction of the outer mucosal or cutaneous surface. Tuberculous ulcers have an undermined edge.
- d. *Raised edge:* Raised edges are produced as a result of invasive cellular disease with necrosis setting in at the center. Pearly-white raised beaded edge is seen in rodent ulcers/basal cell carcinomas.
- e. *Rolled out or everted edge:* Everted edges are seen in malignant ulcers, especially squamous cell carcinoma and adenocarcinomas. Rapidly growing edges of malignant ulcer tends to pile up and spill on to the normal mucosal or cutaneous surface, giving rise to the everted edges.



Figure 5.2

Floor of the ulcer: The exposed clinically visible surface of the ulcer is referred to as the floor of the ulcer.

Aphthous ulcers have a yellowish white floor. Ulcer with a black colored floor may be indicative of a malignant melanoma. Gummatous ulcers have a grayish wash-leather appearance of the floor. Red colored granulation tissue at the floor is suggestive of a healing ulcer. Granulation tissue appearing pale is suggestive of a slowly healing ulcer.

Color of the surrounding mucosa: If the skin or mucosa surrounding the ulcer appears oedematous, erythematous and glossy, the ulcer is said to be acutely inflamed. An erythematous halo is seen around the peripheries of an aphthous ulcer.

Nature of discharge from the ulcer: It is generally difficult to assess the character of discharge from ulcers on the moistened oral mucosa. However, ulcers on the skin surface can be assessed for discharge. Infected ulcers will show purulent discharge. Healing ulcers may show small amount of serous discharge.

Palpation

Examine whether the ulcer is tender/nontender: Aphthous ulcers and ulcers caused by trauma are tender on palpation. Ulcers that are tender signify an acute inflammatory process. Malignant ulcers are generally non tender on palpation. However, malignant ulcers that are secondarily infected can be tender. Ulcers caused by tuberculosis and syphilis are mildly tender on palpation.

Evaluate the margins and edge of the ulcer (Figure 5.3): Margin of the ulcer refers to the junction between the normal epithelium and the ulcer (outer boundary of the ulcer).

Edge of the ulcer is the area between the margin and floor of the ulcer. Intraoral ulcers such as aphthous or traumatic ulcers

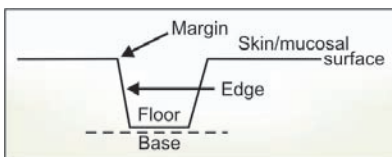


Figure 5.3

are minute therefore the edge and margins cannot be appreciated. However larger ulcers such as those associated with carcinomas can be evaluated. Marked induration (firmness/hardness) of the edge of the ulcer is a feature of carcinomas. However the edges and margins of chronic ulcers are also relatively indurated.

Palpate the base of the ulcer: It should be understood that terms like floor and base should not be interchangeably used. Base of an ulcer refers to the part on which the ulcer “rests”. The base of an ulcer is not seen. Hence, the base cannot be “inspected” but should be felt by means of bidigital palpation. In order to feel for the base of the ulcer, the ulcer can be attempted to be picked up using the thumb and index finger. The base of the ulcer is significantly indurated in malignant ulcers. Chronic ulcers like syphilitic or gummatous ulcers also have an indurated base but of a milder degree when compared to carcinomatous ulcers.

Bleeding on palpation: Mild provocation or palpation of a malignant ulcer may induce bleeding. Granulation tissue within healing ulcers also has a tendency to bleed on palpation.

Relationship to underlying structures: The relationship of the ulcer to the deeper structures can be assessed in the same manner as examining the base of the ulcer. The ulcer should be tried to be moved over the underlying structures. Malignant ulcers will be obviously fixed to the deeper structures because of their infiltrative characteristics. However, ulcers of inflammatory origin can be freely moved over the deeper structures.

Surrounding skin/mucosa: The skin or mucosa surrounding the ulcer should be palpated. The skin surrounding the ulcers can be palpated to assess for raise in local temperature. Raise in temperature is indicative of ulcers that are acutely inflamed. Skin around the ulcer is examined for loss of sensation. Loss of sensation may be seen in nerve lesions such as in lepromatous leprosy.

Examination of regional lymph nodes: The lymph nodes in the location of the ulcer should always be examined. Regional lymph nodes may be enlarged and tender on palpation in acutely inflamed ulcers. Lymph nodes in the region of a tuberculous ulcer may be slightly enlarged, matted and mildly tender on palpation. In advanced stages of a malignant ulcer the regional lymph nodes are stony hard, non tender and fixed to the underlying structures.

ULCERS THAT COMMONLY OCCUR IN THE ORAL CAVITY

Traumatic Ulcer

It is the commonest oral ulcer.

Causes

Mechanical: Vigorous tooth brushing resulting in traumatizing oral tissues, accidental biting of the lip, buccal mucosa and tongue during mastication.

Chemical: Topical application of medicaments (aspirin, clove oil)

Thermal: Consumption of hot food (pizza burns)

Iatrogenic: Trauma to mucosa caused by rotatory instruments, ill fitting dentures

Self inflicted injuries: Seen in mentally challenged individuals

Riga fede disease (ulcer on the tip of the tongue because of natal/neonatal teeth) and orogenital sex (ulcers on the lingual frenum)

Site: Traumatic ulcers are commonly seen on the tongue, lips, mucco buccal fold, gingivae and palate.

Clinical Features

Traumatic ulcers show a cause and effect relationship (removal of the etiology will result in healing of the ulcer). Usually persist for a few days (however, ulcers of the tongue last for a longer time)

They are generally solitary. Borders of the ulcers are erythematous and the base of the ulcer reveals yellowish-white necrotic slough. Painful lymphadenopathy is rarely seen.

Recurrent Aphthous Ulcer (RAS)

Site

Recurrent aphthous ulcers are usually seen on the non keratinised (movable) mucosa. These sites include the lips, buccal mucosa, tongue, floor of the mouth, mucobuccal fold and soft palate.

Initial lesion of RAS: (Figure 5.4)

The initial lesion appears as an erythematous macule or papule, which undergoes central blanching followed by necrosis and ulceration.



Figure 5.4

Clinical Features

Minor RAS: Minor RAS

never occur as solitary lesions, they are generally seen as multiple ulcers.

Shallow ulcers, which are circular in shape

The ulcers are usually small sized about 0.5 to 2 cm in diameter.

The ulcers have a yellow necrotic base and surrounded by an erythematous halo.

Major RAS: Generally seen as solitary ulcers, very rarely 2-3 ulcers can be seen.

These ulcers are greater in size compared to the minor form of RAS, and measure more than 2 cm in diameter.

These are painful ulcers, which persist for months and heal with scar formation.

Herpetiform RAS: These occur as clusters of ulcers over the mucosal surface. These ulcers are painful

Behcet's Syndrome

Patients have recurrent oral aphthous ulcers, recurrent ulcers of the genital region and ocular ulcerations.

Recurrent Intraoral Herpes Simplex

Site

Occurs on the keratinised (fixed) mucosa such as the hard palate, gingivae and alveolar ridge.

Clinical Features

The initial lesions are seen as small discrete gray or white vesicles, which rupture immediately forming small punctate ulcers. The ulcers are usually small measuring less than 1 mm in diameter.

Mature lesions are seen as shallow ulcers measuring less than 0.5 cm in diameter. These ulcers are surrounded by an erythematous halo. Many such small ulcers coalesce to form large ulcers measuring about 1.5 to 2 cms in diameter. Generally patients present with painful cervical lymphadenopathy.

LESIONS COMMONLY SEEN AS SWELLINGS IN THE ORAL CAVITY

Normal anatomic variations

1. Parotid papillae
2. Unerupted teeth
3. Pterygoid hamulus

Developmental conditions

1. Maxillary and Mandibular tori
2. Hemangioma/lymphangioma
3. Hereditary gingival fibromatosis
4. von Recklinghausen's neurofibromatosis

Inflammatory conditions

1. Abscesses (including gingival, periodontal, periapical and pericoronal)

2. Pyogenic granuloma
3. Sarcoidosis
4. Wegner's granulomatosis
5. Orofacial granulomatosis
6. Crohn's disease

Traumatic conditions

1. Traumatic fibroma
2. Epulis
3. Denture induced hyperplasia

Cystic lesions

1. Eruption cysts
2. Cysts of developmental origin
3. Cysts of infective origin

Hormonal conditions

1. Pregnancy tumor

Drug induced

1. Gingival enlargements caused by drugs (Phenytoin, Cyclosporine and Nifedipine)

Neoplasms

1. Leukemia
2. Lymphoma
3. Epithelial tumors
4. Mesenchymal tumors

Miscellaneous

1. Angioedema
2. Amyloidosis
3. Vesiculo bullous disorders
4. Infections

EXAMINATION OF SWELLINGS IN THE OROFACIAL REGION

The term swelling is a vague description an enlargement or protuberance in the body. Some authors prefer to use the term "lump" to describe a swelling. A lump can simply mean a localized mass of body tissue. The term "tumor" has also been

used to refer to a swelling. But tumor is generally used to refer to a swelling that is neoplastic.

For clinical purposes the etiology for swellings to occur in the orofacial region can be congenital, traumatic, inflammatory, neoplastic and miscellaneous.

History

1. When was the swelling first noticed?

Most facial or intraoral swellings are readily visible to the patient. However, the patient does not generally notice swellings such as mandibular tori. Swellings present for a shorter duration are indicative of inflammatory swellings (dentoalveolar abscesses, cellulitis). Benign swellings and chronic inflammatory swellings are present over longer period of time (Ameloblastoma).

2. How did the swelling begin? (Spontaneously, after trauma such as biting lip or tongue, following toothache)

Swelling following trauma can indicate a hematoma, traumatic fibroma. Swelling following tooth pain may indicate a dentoalveolar or periodontal abscess or cellulitis.

3. Has the swelling grown in size, reduced in size or remained the same?

Generally swellings that remain the same size can be tori or exostoses. Rapidly growing swellings signify an acute inflammatory component (cellulitis) or a malignant growth. Slowly growing swellings indicate benign slowly expanding lesions such as intraosseous cysts and tumors or salivary gland tumors. Glandular swellings (sialolith obstructing the ducts of salivary glands) can increase in size during the intake of food.

4. Do you have similar swellings elsewhere in the body?

Presence of multiple swellings is generally rare in the orofacial region. Multiple lymph nodes may be enlarged in a metastatic lesion. Multiple osteomas are present in Gardner's syndrome. Multiple periodontal abscesses may be seen in a patient suffering from uncontrolled diabetes. Hodgkin's disease is generally characterized by multiple lymphoglandular enlargements.



Figure 5.5



Figure 5.6

5. Did you ever have a similar kind of a swelling in the same location earlier?

If the patient reports of a recurrence of swelling in the same location after removal of the swelling, it may imply a malignant change of a benign swelling or a cystic swelling that has recurred because the cyst wall was incompletely removed or a recurrent dentoalveolar abscess.

6. Is it associated with pain, discharge, fever, difficulty in swallowing, inability to open the mouth, difficulty in speech, labored breathing or altered sensation/loss of sensation? Swellings of an acute nature such as abscesses and cellulitis are associated with pain and fever. Benign slowly growing swellings generally cause pressure effects leading to loss of sensation, difficulty in breathing, swallowing and speech. Malignant swellings are generally painless. However in advanced stages, malignant swellings can be painful due to involvement of nerves.

7. Have you consulted any other physician for this problem prior to this visit?

If yes, describe the nature of treatment advised, investigations and reports of the previous consultations.

Nature of treatment advised

Investigations and reports of the previous consultations

Examination

Inspection

Site of the swelling:

Intraoral: (gingiva, tongue, palate, etc.)

Extraoral: the upper, middle and lower one-third of the face on the right or left side.

Certain swellings have a characteristic location of occurrence. Parotid swellings are seen in the pre auricular region and inferior auricular region causing the lifting up of the ear lobe on the affected side. Periodontal abscesses are seen to occur on the gingiva (generally the marginal and interdental gingiva). Cherubism causes bilateral enlargement of the middle and lower thirds of the face (Figure 5.5).

Shape and size of the swelling (oval, spherical, diffuse): The approximate size and shape of the swelling should be recorded. Chronic inflammatory swellings are generally small and have a definite shape. Extraoral swellings such as cellulitis are diffuse in nature.

Number of swellings (solitary, multiple): Generally inflammatory swellings such as abscesses and cysts occur as solitary swellings (Figure 5.6). Metastatic lesions involving nodes and neurofibromatosis occur as multiple swellings.



Figure 5.7

Color of the swelling: A mucocoele/ranula appears bluish. Fibrous swellings such as fibroma may have the same color or could be paler than that of the surrounding mucosa. Skin or mucosa over acutely inflamed swellings may appear erythematous (red). Hematomas caused by the extravasation of blood may appear from red to dark blue to brown (based on the pigments from red blood cells). Melanomas appear brown or black in color. Eruption cysts associated with erupting teeth in children may appear as a bluish colored swelling.

Skin over the swelling: Skin over an acutely inflamed swelling will appear erythematous. The skin may appear glossy and stretched over diffuse swellings such as in cellulitis.

Expansion of cortical plates: Expansion of cortical plates is a feature of intraosseous swellings such as cysts and tumors, fibro-osseous lesions and bacterial infections such as osteomyelitis.

Ulcers/sinus associated with the swelling: Presence of an ulcer is an indication of a traumatized swelling or a secondarily infected swelling. Sinus openings are generally present in swellings of longer duration.

Palpation

1. Confirm the inspectory findings of extent, shape and size of the swelling
2. Evaluate whether the swelling is tender or nontender on palpation

The oral physician should gently apply pressure over the swelling to elicit tenderness. Swellings that are acute inflammatory in nature are the most tender. Chronic inflammatory swellings are generally nontender unless secondarily infected. Mucocoeles, lipomas, fibromas, and papillomas are nontender on palpation. Malignant swellings eroding the bone or involving nerves are generally tender.

2. Consistency of the swelling (soft, firm, rubbery, stony hard)
Generally lipomas, abscesses and cellulitis have a soft consistency. Cysts have a cystic consistency whereas fibromas are firm in consistency. Osteoma, (Figure 5.7) tori have a stony hard or bony hard consistency while lymphomas have a rubbery consistency.

3. Surface of the swelling

Cysts, fibroma, lipoma tend to have a smooth surface on palpation. Malignant swellings have an irregular or rough surface. Pyogenic granuloma can either occur smooth surfaced or lobulated. Papillomas are seen as exophytic nodules with multiple finger like projections.

4. Is there a local raise in temperature?

Local raise in temperature is assessed only for extraoral swellings. Increase in the local temperature may be caused by excessive vascularity of the tumor as a result of infection (cellulitis) or a well vascularised tumor (sarcoma). Temperature is best gauged using the back of the fingers (dorsal surfaces). One hand can be placed on the swelling and the other hand can be placed on the unaffected side, this may help to compare even a minute raise in temperature.

5. Is the swelling sessile or pedunculated?

Pyogenic granuloma, pregnancy tumor, papillomas are generally pedunculated swellings. Osteomas, tori, abscesses are sessile swellings. Peripheral giant cell granulomas can either occur as sessile or pedunculated masses.

6. Palpate gingiva to check for tenderness, bleeding or pus discharge from the gingival sulcus

Gingival tenderness and bleeding from the gingival sulcus indicates acutely inflamed gingiva. Pus discharge signifies the presence of a periodontal abscess.

7. Is the swelling fixed to the underlying structures?

Swellings with distinct margins can be assessed for fixity to underlying structures. The swelling should be pinched up with the thumb and index fingers and moved. The swelling may be freely moving or may be attached to the underlying bone, muscles or the over lying skin. Fixity of the swelling either to the overlying skin or the deeper structures is an obvious sign of malignancy. Some nodular mucosal swellings may be attached to the underlying structures either by a broad base (sessile) or by means of a narrow stalk (pedunculated).

8. Check for mobility of teeth associated with the swelling

Intra osseous vascular malformation can result in mobility of teeth. Teeth are mobile in periodontal abscesses. Intraosseous cysts, tumors and fibro osseous lesions causing the resorption of the roots of teeth can cause mobility. Carcinomas involving the alveolus also tend to cause mobility of teeth.

9. Is the swelling fluctuant, reducible or compressible? (Figure 5.8A)

Fluctuation: Based on the size of the swelling test for fluctuation can be carried out.

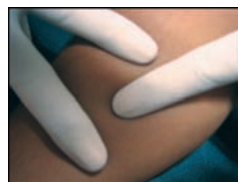
For large swellings: 2-3 fingers of one hand are placed on one margin of the swelling. While fingers of the other hand are used to apply pressure over margin of the swelling on the other side. If the swelling is fluctuant, fingers of the first hand will be slightly elevated.

For small swellings: To stabilise the swelling, index and middle fingers of one hand are placed slightly apart over the surface of the swelling. Index finger of the other hand is used to apply pressure in the center of the swelling. The fingers that were used to stabilize the swelling can perceive fluctuance.

For extremely small swellings (Figure 5.8B): *Paget's test* (Figure 5.8B) is performed to test for fluctuance in swellings that cannot accommodate two fingers. Pressure is applied with the fingertip over the center of the swelling. If the swelling contains fluid, it will be soft at the center compared to the peripheries. However, a solid swelling will be firmer at the center compared to its periphery.

Reducibility: A swelling that reduces in size and *ultimately disappears* when pressure is applied is referred to as reducible. Reducibility is a characteristic feature of hernia and lymph varix.

Compressibility: A swelling that reduces in size *but does not disappear completely* when pressure is applied is referred to as compressible. Compressibility is a characteristic feature

**A****B****Figure 5.8**

of vascular malformations such as arterial, venous and capillary hemangiomas (Figure 5.9). Lymphangiomas are also compressible.



Figure 5.9

Edge and margins of the swelling: The margins of a swelling

can be palpated using the tips of fingers. Swellings that have distinct margins tend to slip away from the finger during palpation. Both the cyst and lipoma have a smooth surface and distinct margins. When a cyst is palpated using the fingertips the cyst yields to the finger pressure, whereas when a solid tumor such as lipoma is palpated, it does not yield to finger pressure but slips away from it.

11. Is the swelling pulsatile?

There are three reasons when a swelling may be pulsatile. A highly vascular swelling can be pulsatile such as a telangiectatic sarcoma

A swelling that arises from an artery (expansile pulsation)

A swelling that lies in close proximity to an artery (transmitted pulsation)

Pulsations are felt in aneurysms and highly vascular tumors such as a carotid body tumor.

Pulsatility can be assessed by placing the index and middle finger over the suspected swelling as far apart as possible.

If the fingers are raised and separated with each throb of the artery then the pulsation is said to be expansile in nature. If the fingers are only separated but not raised with every throb of the artery then the pulsation is said to be transmitted.

12. Check for decortications or areas of “egg shell cracking”

Intra osseous swellings (ameloblastoma, dentigerous cyst, odontogenic keratocyst) can cause expansion of the cortical plates as they grow in size. Palpation of the cortical plates can sometimes elicit crepitus. Crepitus or a feeling of

eggshell cracking can be felt due to the thinning and subsequent destruction of the cortical plates.

Percussion

Check for tenderness of teeth associated with the swelling.

If teeth are tender when percussed, it relates to swelling of acute nature or an acute exacerbation of a chronic infection. Teeth are generally tender on vertical percussion in acute dentoalveolar abscess, phoenix abscess, infected periapical granuloma and cyst. In periodontal abscess teeth are generally tender on horizontal percussion.

Auscultation

Swellings that are pulsatile can be further auscultated using a stethoscope to check for bruits and vascular murmurs.

Examination of Regional Lymph Nodes

Assessment of associated regional lymph nodes is particularly useful when a malignant lesion is suspected.

Transillumination and Aspiration

Aspiration and transillumination of the swelling can be undertaken to assist in arriving at a clinical diagnosis. However, transillumination is rarely useful in the assessment of swellings of the orofacial region.



Evaluation of Oral Precancers and Oral Cancers

PRECANCEROUS LESIONS AND CONDITIONS

Precancerous Lesion

Precancerous lesion is a morphologically altered tissue in which cancer is more likely to occur than its apparently normal counterpart.

Examples: Erythroplakia, Leukoplakia, palatal changes associated with reverse smoking

Precancerous Condition

Precancerous condition is a generalized state associated with a significantly increased risk of cancer.

Examples: Oral submucous Fibrosis, Sideropenic dysphagia (Plummer-Vinson syndrome/Paterson-Brown-Kelly syndrome), Syphilitic glossitis, Erosive and/or Bullous Lichen planus, Dyskeratosis congenita, xeroderma pigmentosa and chronic discoid lupus erythematosus.

Leukoplakia

The term leukoplakia simply implies a “white patch”. Leukoplakia is strictly a clinical term and does not refer to any specific histopathological alteration of the tissues.

Leukoplakia is a non scrapable whitish patch or plaque that cannot be characterized clinically or pathologically as any other disease, and is not associated with any physical or chemical causative agent except the use of tobacco.

Clinical Features of Leukoplakia

1. Leukoplakia is seen more frequently in patients with a smokeless form of tobacco habit.
2. Generally seen more commonly in men.
3. Usually seen in individuals older than 40 years of age. The prevalence of leukoplakia increases with increase in age.
4. Common sites that are involved include the buccal mucosa, vermillion border of the lower lip, commissural regions, gingiva and the vestibular regions. The palate, retromolar areas, floor of the mouth and tongue are rarely involved.
5. Leukoplakia is generally asymptomatic

Clinical Forms of Leukoplakia

Four basic clinical types of leukoplakia are seen:

Homogenous white plaques (Figure 6.1): They do not have a red component but have a fine white grainy texture or more mottled rough appearance. These lesions are seen as well defined white patches that are slightly elevated. The surface of these lesions appear fissured, wrinkled or corrugated. These patches are nontender, and feel leathery or like “cracked mud” on palpation.



Figure 6.1

Speckled leukoplakia or nodular leukoplakia: This form of leukoplakia reveals multiple keratotic white patches that are distributed over an erythematous atrophic epithelium. Speckled leukoplakia has the greatest potential of undergoing malignant transformation.

Combination of red and white patches: Demonstrates segregation of the red and white components and are basically erythroleukoplakic lesions

Verrucous leukoplakias: They possess both red and white components but the white components are much thicker and protrude above the surface mucosa. Some lesions may reveal a papillary surface or an exophytic growth. Verrucous Leukoplakia is generally seen in older individuals with the peak incidence in the 7th and 8th decade.

Leukoplakia based on response to treatment may be divided into:

1. *Reversible leukoplakia:* This form of leukoplakia disappears completely with the removal of the chronic irritating agent. The term pre leukoplakia is sometimes used to refer to reversible leukoplakia.
2. *Irreversible leukoplakia:* Persistent lesions of leukoplakia are referred to as irreversible leukoplakia. These lesions are indicated for a histopathological examination especially if associated with a red component.

Malignant Potential of Leukoplakia

Various studies have shown that the malignant potential of leukoplakia ranges from 3 to 5 %. However not all forms of leukoplakia have a malignant potential. It depends on the type of leukoplakia, the site, patient's age and sex, etiology and the general health of the patient.

The so-called high risk leukoplakias are the leukoplakias situated in the "high risk oval" in the oral cavity and leukoplakias that have a red component (speckled leukoplakia). Only 0.5 to 1.7% of homogenous leukoplakias undergo malignant transformation (Figure 6.2).

Features of epithelial dysplasia

Enlarged nuclei and cells

Increased nuclear-to-cytoplasmic ratio

Large and prominent nucleoli

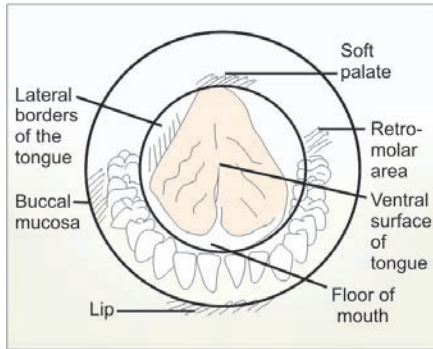


Figure 6.2: High risk oval

Hyperchromatic (excessively dark-staining) nuclei
 Pleomorphic (abnormally shaped) nuclei and cells
 Increased mitotic activity (excessive numbers of mitoses)
 Abnormal mitotic figures (tripolar or star-shaped mitoses, or mitotic figures above the basal layer)
 Dyskeratosis (premature keratinization of individual cells)
 Loss of polarity (lack of progressive maturation toward the surface)
 Keratin or epithelial pearls (focal, round collections of concentrically layered keratinized cells)
 Loss of typical epithelial cell cohesiveness

Staging of Dysplasia

Mild epithelial dysplasia

Alterations limited principally to the basal and parabasal layers

Moderate epithelial dysplasia

Involvement from the basal layer to the midportion of the spinous layer.

Severe epithelial dysplasia

Alterations from the basal layer to a level above the midpoint of the epithelium.

Examination of Leukoplakic Lesion

History

1. When was the patch first noticed? In most cases leukoplakic patch is generally an incidental finding as the lesion is asymptomatic. Patient is aware of the lesion only if it is present on visible areas of the oral cavity such as the tongue, lips, gingiva or inner aspects of the cheek.
2. Does the patient have burning sensation or pain in the region associated with the lesion? (It will help to rule out candidiasis or a suspicion of an erythroplakic change)
3. Has the patient placed cloves, topical medicaments or reports to have eaten hot food in the recent past? (To rule out chemical or thermal burns)
4. Does the patient have the habit of lip biting, cheek chewing, etc.
5. Is the patient presently on medication for an underlying systemic illness?

Habit History

Do you smoke/chew tobacco? Do you use snuff?

Tobacco in the form of smoking

1. Number of beedis/cigarettes/cigars that are smoked per day?
2. For how many years have you been smoking?
3. Do you indulge in reverse smoking?

Tobacco in the chewable form

1. What form of chewable tobacco is used?
 - a. Betel leaf + betel nut/ areca nut +Tobacco
 - b. Betel leaf+ tobacco +slaked lime
 - c. Branded chewable tobacco products such as Zarda, Pan Masala, Khaini
2. How many times in a day is tobacco chewed?
3. Since how many years has the patient chewed tobacco?
4. Does the patient chew and spit the tobacco or chew and swallow?

5. Which region does the patient place the betel quid? (Labial vestibule of the lower lip/buccal vestibule)

Does the patient consume alcohol along with tobacco?

1. Amount of alcohol consumed per day
2. Since how long has the patient been consuming alcohol
3. Form of alcohol (arrack/branded alcohol)

Intraoral Examination

Inspection

1. Mention the site involved. (Such as buccal mucosa, retro-molar area, commissures)
2. Mention the approximate extent of the lesion
3. Mention the surface coloration of the lesion (white, red and white patches, predominantly reddish regions)
4. Comment on the surface features (papillary, ulcerated)
5. Describe the appearance of the surrounding mucosa (normal, erythematous, ulcerated)

Palpation

1. Evaluate whether the lesion is scrapable (nonkeratotic) or not scrapable (keratotic). Scrapability can be evaluated using a dry piece of sterile gauze, blunt end of an instrument, or a tongue blade
(Leukoplakic lesions are keratotic. Thermal burns, chemical burns and most forms of candidiasis (except chronic hyperplastic form) are scrapable)
2. Appreciate the surface characteristics of the patch. (papillary, dry cracked mud, leathery)
3. Is the lesion tender on palpation?

Clinical and histological staging of leukoplakia (adapted from Axell T et al and Schepman KP et al)

The staging of Leukoplakia is made based on the extent/size of the lesion, site involved the clinical appearance of the lesion and the extent of dysplasia.

*Provisional diagnosis (clinical diagnosis)**Extent of Leukoplakia (L)*

LX- size of the lesion not assessed/not specified

L0- no evidence of the lesion

L1- size of the lesion less than or equal to 2 cm

L2- size of the lesion between 2-4 cm

L3- size of the lesion greater than or equal to 4 cm

Site of the leukoplakic lesion (S)

SX- site of involvement not assessed/not specified

S1- any/all sites of the oral mucosa except the floor of mouth and/or tongue

S2- Lesion involving the floor of the mouth and /or tongue

Clinical characteristics of the lesion (C)

CX- clinical characteristics of the lesion not assessed/not specified

C1- Homogenous lesion

C2- Non Homogenous lesion

*Histopathological Diagnosis**Histopathological features (P)*

PX- Histopathologic features not specified/not assessed

P1- no dysplastic features

P2- Mild dysplasia

P3- Moderate dysplasia

P4- Severe dysplasia

Staging

Stage 1- Any L, S1, C1, P1 or P2

Stage 2- Any L, S1 or S2, C2, P1 or P2

Stage 3- Any L, S2, C2, P1 or P2

Stage 4- Any L, Any S, Any C, P3 or P4

*Investigations**Histopathological analysis*

Generally most homogenous leukoplakic lesions do not warrant histopathological analysis

Leukoplakic lesions interspersed with red patches are ideally biopsied. These lesions should be stained using Toluidine blue in order to identify the most representative site for a biopsy.

Lichen Planus

Lichen Planus is a chronic inflammatory disease that affects skin and mucosa of squamous cell origin. Erasmus Wilson coined the term lichen planus in 1869.

Although the etiology of Lichen Planus is still unknown, however available evidence suggests that Lichen planus represents a cell mediated immunological response to an induced antigenic change in the skin or mucosa.

The oral form of lichen planus seems more common than the cutaneous form and the oral lesions may occur independently of the skin lesions.

Clinical Features

Cutaneous lichen planus: Faint erythematous or violaceous papules are seen. The papules are generally polygonal in shape and flat topped. Some papules show the presence of fine white lines or puncta (Wickham's striae).

The papules are seen over the flexural side of the wrist. Other areas that are affected are the arms and legs, thighs, lower back; trunk and neck may also be affected. The face and scalp are spared in classic Lichen planus. Generally, the lesions of Lichen planus are extremely pruritic. However 20% of the affected individuals are asymptomatic.

Lichen planus involving nails: Nail changes have been reported in up to 16% of the individuals affected with Lichen planus. Typically nails involvement is seen along with cutaneous and oral involvement. Generally few nails of the fingers or toes are affected (Figure 6.3).

Involved nails show longitudinal ridging and grooving. Some times splitting of nails (onychoschizia), shedding (onychomadesis), longitudinal striation (onychorrhaxis), absence of the nail (anonychia), subungual hyperkeratosis and thinning of the nail plates may been seen.



Figure 6.3: Lichen planus affecting nail

Pterygium (an abnormal extension and adherence of the cuticle of the nail over the proximal portion of the nail plate) formation is one the classic signs of Lichen planus of the nails. Pup tent sign is another classic feature of lichen planus affecting nails. In this sign, the nail plate splits longitudinally and the lateral edges angle downward. This feature can be appreciated when the nail is viewed from the tip.

However one should remember that the nail changes associated with Lichen planus are not pathognomic of the condition as these nail changes can also occur in fungal infections, trauma, drug reactions, systemic illness and other skin diseases.

Lichen planus involving mucous membrane: Mucosal lesions of lichen planus involving the oral cavity, esophagus, conjunctivae, bladder, nose, larynx, stomach, genitalia and anus have been reported.

Oral lichen planus (Figure 6.4): The oral manifestations of lichen planus may occur weeks to months before the cutaneous lesions are evident. It has also been seen that some patients who have oral lesions do not develop cutaneous lesions.

Site distribution: Oral lichen planus is invariably a disease that affects regions of the oral cavity bilaterally. Oral lesions usually involve the posterior buccal mucosa, or less commonly the tongue and although any site can be involved palatal and sublingual lesions are not common.

**Figure 6.4**

Intraoral lesions of lichen planus based on their presentation can be categorized as reticular, erosive, plaque like (hypertrophic), atrophic, papular, bullous and ulcerative forms.

Age: Lichen planus predominantly is a disease of the middle aged and elderly with a peak incidence in 30 to 70 year olds. Occasionally children are affected.

Sex: Lichen planus affects both sexes. However 60-65% affected are females.

Reticular lichen planus: One of the more common forms of lichen planus. The lesions are so called as they have a characteristic interlacing white lines, which are referred to as Wickhams striae. These lesions are not static, they appear and disappear over weeks and months. Sometimes the striae can appear in the form of papules and this form of lichen planus may be referred to as *Papular Lichen planus*.

Reticular form of lichen planus is usually asymptomatic. It typically involves the posterior buccal mucosa bilaterally. It may also involve the gingivae, palate and vermillion border of the lips.

Erosive lichen planus: It is the second most common form of Lichen planus. Patients are generally more worried about this form of Lichen planus as it is symptomatic. Patients complain of

burning sensation in the oral cavity and inability to consume spicy food. Patients with this form of lichen planus develop carcinophobia. The mucosa appears erythematous with central erosions. Severe form of this condition reveals ulcerative lesions that can be described as *ulcerative Lichen planus*. The peripheries of the erosive areas are bounded by fine white radiating striae.

If the erosive nature of the lesion is severe, epithelial separation can occur. This results in the relatively rare presentation of *Bullous Lichen planus*.

Atrophic lichen planus: Atrophic lichen planus is clinically manifested as smooth, poorly defined erythematous areas on the oral mucosa. Some lesions reveal the presence of peripheral striae around the erythematous region.

Hypertrophic lichen planus: It is evident as well circumscribed elevated white lesions on the oral mucosa, which resembles the plaque like lesions of leukoplakia. History of smoking may be indicative of Leukoplakia. However, a biopsy of the lesion is indicated in such cases to differentiate between lichen planus and Leukoplakia.

Malignant potential of oral lichen planus: Over a period of 5 years less than 1% of all oral lichen planus turn into squamous cell carcinoma. Erosive form of lichen planus has the greatest potential for malignant transformation.

Clinical Examination of Lichen Planus

History

1. When did the patient first notice the lesion?
2. Is the patient aware of any other skin lesions especially on the legs?
3. Are the skin lesions pruritic (itchy)?
4. Does the patient experience burning sensation in the mouth especially inability to eat spicy food?
5. History of teeth being restored with silver amalgam, fabrication of crowns, acrylic prosthesis
6. History of medication over a prolonged period for systemic illness

Personal History

Assess the socioeconomic status of the patient. It has been reported that stress can be a predisposing factor for lichen planus. (Questions regarding the occupation, number of family members, living conditions can be asked)

Clinical Examination

Extraoral examination

Inspection

1. Inspect the skin surface and record the site of involvement
Examine the flexor aspects of the wrists, forearms, inner aspect of the knees, thighs and trunk.
2. Comment on the site and the appearance of the lesion
Skin lesions are generally flat-topped papules covered by a glistening scale. These papules appear sharply demarcated from the surrounding skin. Initial lesions appear red but over a period of time assume a purplish or violaceous hue. The top of these papules may show the characteristic fine grayish white lines referred to as Wickham's striae.

Intraoral Examination

Inspection

1. Record the site of involvement. (Lichen planus generally appears bilaterally)
2. Comment of the approximate extent of the lesion
3. Record the surface characteristics of the lesion. (Lacy fine network, plaque like (hypertrophic), erosive appearance of the lesion with the characteristic radiating white striae at the periphery of the lesion).
4. Examine the teeth in close proximity to the lesion (note the presence of fillings especially large restorations on the buccal and proximal surfaces.
5. Also make a note of the use of dentures (complete/partial).

Palpation

1. Assess whether the lesion is keratotic or not
2. Examine for tenderness on palpation

Investigations

Biopsy: Most lesions of Lichen planus are not indicated for histopathological examination. Erosive lichen planus may be examined histopathologically to assess for dysplastic features. Hypertrophic form of lichen planus resembles homogenous leukoplakia. In order to differentiate this condition from leukoplakia the lesion can be biopsied.

Patch test: When lichenoid reaction is suspected secondary to allergic response to silver amalgam or acrylic of the denture, patch test can be performed. (Lichenoid reaction generally occurs unilaterally unless those caused because of drug allergy which usually occur bilaterally)

Oral Submucous Fibrosis (OSMF)

OSMF is considered a high-risk premalignant condition. Initial reports of this condition were described way back in 1952 and then the condition was termed Atropia idiopathica (tropica) mucosae. In 1953 the term 'Oral Submucous Fibrosis' was introduced. Since then this condition has also been called Idiopathic scleroderma of the mouth, Idiopathic palatal fibrosis and sclerosing stomatitis.

Pindborg and Sirsat defined OSMF as an insidious chronic disease affecting any part of the oral cavity and sometimes the pharynx. Although occasionally preceded by and or associated with vesicle formation, it is always associated with juxta epithelial inflammatory reaction followed by a fibroelastic change of the lamina propria, with epithelial atrophy leading to stiffness of the oral mucosa and causing trismus and inability to eat.

The World Health Organization (WHO) defined OSMF as a slowly progressing disease characterized by formation of fibrous bands which form a blanched oral mucosa resulting in severe restriction of movement of mouth.

Clinical Features

1. Commonly affects individuals in the age group of 20-40 years

2. Both the sexes are almost equally affected. However a predominance of women was seen in many studies
3. Buccal mucosa and retromolar areas are commonly affected. However other sites that are affected are the soft palate, faucial pillars, uvula, tongue and labial mucosa. Based on the form of arecanut chewing habit, the anterior regions or posterior regions of the oral mucosa are involved. In the "spit" form of the chewing habit anterior regions of the oral mucosa like the buccal mucosa, labial mucosa are involved. In the "swallow" form of the chewing habit the posterior regions of the oral cavity such as the faucial pillar region, palate and the uvula are affected.
4. Excessive pigmentation or occasionally loss of pigmentation of the vermillion border of the lip.
5. Initial symptoms of the disease are burning sensation of the oral mucosa, aggravated by the intake of spicy food (Stomatopyrosis), vesiculation, excessive salivation, ulceration and dryness of the mouth.
6. Earliest sign of the disease may be localized or diffuse pallor of the oral mucosa. The thinning of the epithelium and minimal vascularity in the region causes pallor.
7. In the later stages mucosa may become stiff. Vertical fibrous bands are palpable.
8. In severe labial involvement lips appear leathery and there may be difficulty in everting them.
9. Interincisal distance may become less than 35 mm (Figure 6.5)



Figure 6.5: Reduced mouth opening



Figure 6.6

10. Uvula when involved, becomes short and appears like a "bud" (Figure 6.6)
11. Tongue when affected can exhibit depapillation. In severe cases the tongue protrusion may be markedly impaired.

ORAL SUBMUCOUS FIBROSIS DATA SHEET

Identifying data

Case no. _____ Date _____
 Name: _____ Hospital: _____
 Age: _____ O.P. no. _____
 Sex: _____
 Marital Status: Single/ Married _____
 Occupation: _____
 Address: _____

Chief Complaint

Incidental Finding	Burning Sensation	Difficulty in mouth opening	Any other
	Duration Intake of spicy food All times	Duration Progressive Static	

Associated Systemic Conditions

Anaemia	Diabetes	Hypertension	Any other
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Personal History

Betel leaf & nut	Betel leaf, nut, slaked lime with tobacco	Plain tobacco	Branded tobacco (Gutka, zarda)
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Brand:

Frequency per day:

No. of Years:

Associated oral habits

Cigarettes	Beedi	Alcohol	Any other
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Family History

H/O oral cancer in family members

SPECIFIC EXAMINATION

Burning Sensation (Visual Analog Scale)

0	1	2	3	4	5	6	7	8	9	10
Mouth Opening					Cheek Elasticity					
Interincisal (mm)	Intercanine Inter Alv. Ridge (mm)				Right side (mm)		Left Side (mm)			

Pallor/Blanching of the Oral Mucosa

Labial Mucosa	Buccal Mucosa	Hard Palate	Soft Palate, Uvula, Fauces	Tongue	All Sites
R L BL					

Fibrous Bands

Buccal Mucosa	Faucial Region	Circum Oral	Other Sites
R L BL	R L		

Tongue Protrusion (mm):

Vesiculation / Ulceration: Present/Absent

Site:

Other Associated Oral Lesions

Leukoplakia	Lichen Planus	Oral Cancer	Any other
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Clinical Staging of Oral Submucous Fibrosis

<i>Grade I (Incipient) Very early stage</i>	<i>Grade II (Mild) Early stage</i>	<i>Grade III (Moderate) Moderately advanced</i>	<i>Grade IV (Severe) Advanced stage</i>
Burning sensation Dryness of mouth Vesicles+ulceration	Burning sensation Dryness of mouth	Burning sensation Dryness of mouth	Burning sensation Dryness of mouth
Inability to consume spicy food	Inability to consume spicy food	Inability to consume spicy food	Inability to consume spicy food
No change in mucosal color	Mucosa blanched Loss of elasticity	Blanched, opaque leather like mucosa	Blanched, opaque leather like mucosa
Fibrous bands non palpable	No clear cut fibrotic bands	Vertical fibrotic bands on the buccal mucosa	Vertical fibrotic bands on the buccal mucosa, retro molar area and pterygomandibular raphe
Normal mouth opening	Slight restriction in mouth opening	Considerable restriction in mouth opening	Very minimal mouth opening
Normal tongue protrusion	Normal tongue protrusion	Tongue protrusion mildly affected	Definite restriction in tongue protrusion
-	-	Difficulty in eating and speaking	Eating and speaking severely impaired
-	-	Poor oral hygiene	Oral hygiene very poor

Clinical and Functional staging of OSMF, proposed by SM Haider et al.**Clinical stage**

1. Faucial bands only
2. Faucial and buccal bands
3. Faucial, buccal and labial bands

Functional stage

- A. Mouth opening less than or equal to 20 mm
- B. Mouth opening 11-19 mm
- C. Mouth opening less than or equal to 10 mm

Malignant Potential of Oral Submucous Fibrosis

In India, the frequency of OSMF among oral cancer patients is 40 patients for every 100 patients affected with oral squamous cell carcinoma. The malignant transformation rate of OSMF ranges from 3 to 6%.

ORAL CANCER

Oral cancer is a term used to describe any malignancy that arises from the oral tissue. However, the term “oral cancer” is generally used with reference to squamous cell carcinoma as they represent almost 90-95% of all cancers affecting the oral tissues. It is estimated that 56,000 new cases of oral cancers occur every year in India.

Types of Intraoral Malignancies

1. Primary
 - a. Squamous cell carcinoma (90-95%)
 - b. Malignancies affecting the salivary glands
 - c. Mesenchymal, osteogenic sarcoma and chondrosarcoma
 - d. Melanoma
 - e. Verrucous carcinoma
2. Systemic
 - a. Metastatic carcinoma
 - b. Multiple myeloma
 - c. Lymphomas and leukemia
 - d. Kaposi's sarcoma

Types of Perioral Malignancies

1. Malignancy of the maxillary sinus
2. Basal cell carcinoma of the face
3. Cervical lymph node metastasis
4. Cancers affecting the parotid and submandibular salivary gland

Clinical Appearances of Oral Cancers (Squamous Cell Carcinoma)

Oral cancers have various clinical appearances (Figure 6.7)

1. Ulcerative appearance (also called infiltrative)
2. Exophytic appearance
3. Verrucous appearance

Etiology

Etiology for oral cancer is said to be multifactorial.



Figure 6.7

Risk Factors

1. Smoking cigarettes/beedis/cigars
2. Use of smokeless tobacco (snuff, chewable form of tobacco)
3. Drinking of alcohol (at least units 90 ml or more of it per day)
4. Betel nut, slaked lime
5. Age over 40 years
6. Accumulation of high doses of x rays over a period of years
7. Patient infected with HIV or other immunodeficiency states
8. Previous history of oral cancer
9. Family history of oral cancers
10. Chronic mechanical irritation (sharp teeth, sharp denture edges)

Symptoms and Signs of Oral Cancer

Lump or swelling
Crust
Nonhealing persistent ulcer
Pain or tenderness
Bleeding
Loose teeth
Swelling in the neck
Change in taste sensation
Altered sensation (paraesthesia, hyperesthesia or anesthesia)
Change of voice
Difficulty in swallowing
Diplopia
Increased salivation

Clinical Appearances of Oral Cancer

1. Patch or plaque
 Red lesion
 White lesion
 Red and white lesion

2. Exophytic surface
 - Red
 - White
 - Pink
 - Multicolored
 - Ulcerated
 - Non ulcerated
3. Ulcerated
4. Crusts
5. Bluish, brown or black lesion
6. Bleb

General History

1. When did the patient first notice the mass?
2. Has the mass grown in size since then?
3. Is it associated with pain, difficulty in swallowing, eating, speech, breathing or loss of sensation?
4. Has the patient noticed any discharge from the mass?
5. Is the patient aware of loss of body weight?
6. Has the patient consulted any other physician for this problem prior to this visit?
 - If Yes, describe the nature of treatment advised:
 - Investigations and reports of the previous consultations
7. Is the patient aware of anybody else in his family who suffers from the similar ailment?
 - (H/o of oral cancers)

Habit History

Do you smoke/chew tobacco? Do you use snuff?

Tobacco in the form of smoking

1. Number of beedis/cigarettes/cigars that are smoked per day?
2. For how many years have you been smoking?
3. Do you indulge in reverse smoking?

Tobacco in the chewable form

1. What form of chewable tobacco is used?
 - a. Betel leaf + betel nut/areca nut +Tobacco
 - b. Betel leaf+ tobacco +slaked lime
 - c. Branded chewable tobacco products such as Zarda, Pan Masala, Khaini
2. How many times in a day is tobacco chewed?
3. Since how many years has the patient chewed tobacco?
4. Does the patient chew and spit the tobacco or chew and swallow?
5. Which region does the patient place the betel quid? (Labial vestibule of the lower lip/buccal vestibule)

Tobacco in the form of Snuff

1. How many times in a day is snuff used by the patient?
2. Since how many years has the patient used snuff?

Does the patient consume alcohol along with tobacco?

1. Amount of alcohol consumed per day
2. Since how long has the patient been consuming alcohol
3. Form of alcohol (arrack/branded alcohol)

Examination of the Lesion

Extraoral

Examine the lymph nodes of the head and neck region

If the lymph nodes are palpable comment about the location, number, tenderness, fixity and consistency of the nodes.

Examine the orofacial region for presence of ulcers, sinus openings and scars (scars might indicate history of surgical treatment)

Intraoral

Inspection

1. Examine all mucosal surfaces (gingiva, buccal mucosa, labial mucosa, alveolar mucosa, hard and soft palate, vestibular



Figure 6.8



Figure 6.9

- regions, retromolar regions, tonsillar and faucial pillar region, oro pharynx)
2. Examine teeth for mobility and tenderness
3. Describe the appearance of the lesion (ulcerative, exophytic) (Figures 6.8 and 6.9)
4. Mention the location of the lesion
5. Describe the approximate extent of the lesion (the anteroposterior and superoinferior extent)
6. Describe the approximate size of the lesion
7. Mention the features of the ulcer (edge, margins, floor)
8. Inspect for discharge from the lesion (pus, blood)
9. Comment about the appearance of the surrounding mucosa (normal, erythematous, white lesion, red and white lesion)

Palpation

Confirm the extent and size of the lesion

Assess whether the lesion is tender or non tender on palpation

If ulcerated is the base indurated

Investigations

Radiographs

1. Intraoral lesions in close proximity to the hard tissues warrant the use of radiographic investigations. (Lesions involving

the alveolar mucosa, vestibular region, retromolar region, palate and gingiva)

2. Begin with a screening Orthopantomogram and Intraoral periapical radiograph in the region of the suspected bone involvement. Intraoral periapical radiographs are indicated for assessing any alteration in trabecular pattern of bone.
3. Water's view is advocated for lesions that are suspected to involve the maxillary sinus and orbits.
4. Advanced imaging techniques like MRI and CT are useful to assess the depth and extent of the lesion and involvement of underlying structures. Bone scanning can be used to assess metastasis to distant sites.

Biopsy

1. Depending on the size and site of involvement, incisional, excisional or punch biopsy is recommended.
2. Involvement of lymph nodes may be assessed using fine needle aspiration biopsy.

Clinical Staging of Oral Cancer (TNM Classification)

(T- Primary tumor (size of the tumor at its greatest diameter in cm), N-regional lymph nodes, M-distant metastasis)

TX- Primary tumor cannot be assessed

T0-No evidence of primary tumor

TIS-Carcinoma in situ

T1-Tumor less than or equal to 2 cm

T2-Tumor size greater than 2 cm but less than or equal to 4 cm

T3-Size of the tumor greater than 4 cm

T4-size of the tumor greater than 4 cm with invasion into underlying/adjacent structures (antrum, tongue, muscles, skin)

NX-Regional lymph nodes cannot be assessed

N0-no clinically positive nodes

N1-single clinically positive homolateral node less than or equal to 3 cm

N2 (further classified into N2a, N2b, N2c)

N2a-single clinically positive homolateral node greater than 3 cm but less than or equal to 6 cm

N2b-multiple clinically positive nodes less than or equal to 6 cm

N2c-Bilateral nodes or contralateral nodes greater than 6 cm in size

N3-Metastasis to a regional lymph node greater than 6 cm in diameter

MX- Distant metastasis was not assessed

M0-no evidence of distant metastasis

M1-distant metastasis is evident

Staging	5-year survival rate
Stage 0- TIS, NO, MO	
Stage I- T1, NO, MO	85%
Stage II- T2, NO, MO	66%
Stage III T3, NO, MO	41%
T1, T2 OR T3, N1, MO	
Stage IV T4, NO OR N1, MO	9%
ANY T, N2 OR N3, MO	
ANY T, ANY N, M1	



Evaluation of Fractures of Maxillofacial Skeleton

Maxillofacial injuries can be caused as a result of road traffic accidents (RTA), interpersonal violence, falls sustained during domestic work and daily activities, industrial trauma and sporting injuries.

Traumatic injuries to the maxillofacial region can be broadly categorized as:

- Traumatic injuries to the middle third of the face (mid facial skeleton).
- Traumatic injuries to the mandible

The maxillofacial skeleton can be roughly divided into three regions:

1. Upper third: Formed by the frontal bone (very rarely fractured)
2. Middle third: Area extending downwards from the frontal bone to the upper teeth/alveolus
3. Lower third: Mandible

EXAMINATION OF THE PATIENT

1. Detailed history of the Injury

When did the accident take place?

How was the injury sustained? (cause and nature, ask if it was RTA, fall, etc. direction of impact)

Did the patient lose consciousness? (indicative of cerebral injury)

Did the patient have difficulty in breathing and swallowing?

Does the patient have headache or pain else where in the body?

Did the patient experience bleeding from the nose, ear, and mouth?

Does the patient have paraesthesia, anaesthesia over any area over the face?

Did the patient receive emergency treatment in a hospital? (details of the treatment, investigative records such as X-rays, scans, blood reports, medication received, any surgical intervention undertaken)

2. Relevant medical history

Ask the patient if he/she is diabetic, hypertensive or immunocompromised steroid therapy or anticoagulant therapy and known allergy to any medications.

3. Local examination

Preliminary steps: Use cotton swabs to remove coagulated blood and dirt over the face and in the oral cavity.

Extraoral Examination

Inspection

1. Make a note of soft tissue lacerations
2. Obvious facial asymmetry should be recorded
3. Record sites of oedema and ecchymosis (Figure 7.1)
4. Check for diplopia

To check for diplopia: An object or a finger can be held at arm lengths away in front of the patient's eyes. The patient is asked to report double vision as the object is moved. Diplopia is tested in all the nine positions of gaze (Figure 7.2)

Palpation

1. Cranium is examined for soft tissue wounds
2. Palpate the zygomatic bone, zygomatic arches, orbital rims and the nasal complex and make a note of tenderness, step deformity or unnatural mobility
3. Trace the outline of the mandible bilaterally and record sites of tenderness or step deformities

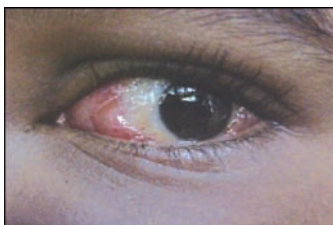


Figure 7.1



Figure 7.2

4. Evaluate the movement of the mandible (note difficulty in opening, closing, lateral excursions, deviation and deflection)
5. Make a note of sites with paraesthesia or anesthesia.

Intraoral Examination

Inspection

1. Make a note of all avulsed teeth, fractured teeth.
2. Inspect for deranged occlusion.
3. Make a note of lacerations, hematoma formation and degloving injuries.

Palpation

1. Sites of tenderness and step deformities are recorded.
2. Mobility of teeth and alveolus are checked.
3. Check for mobility of the middle third of the facial skeleton.

Percussion

1. Teeth in the suspected site of fracture are percussed and teeth that produce a cracked pot sound (sound produced when cracked porcelain is tapped with a spoon) and those that are tender on percussion are recorded.

Fractures of the Middle Third

Types

1. Dentoalveolar fractures
2. Zygomatic complex fractures
3. Nasal Complex fractures
4. Orbital floor fractures
5. Le Fort I, low level fractures or Guerin fracture
6. Le Fort II, Infrazygomatic fractures or Pyramidal fractures
7. Le Fort III or Suprazygomatic fractures

Dentoalveolar Fractures

Signs and Symptoms

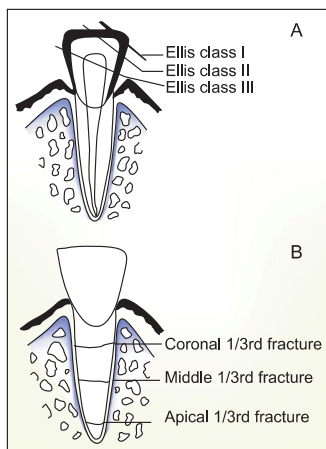
1. Laceration of the upper lip and degloving injury of the alveolus
2. Crown fractures, vertical splitting of teeth, root fractures (Figures 7.3 A and B)
3. Mobility of teeth
4. Avulsed teeth (sites of avulsed teeth to be evaluated for retained roots)
5. Fractured maxillary tuberosity and antral floor
6. Derangement of occlusion
7. Midline palatal split
8. Teeth are tender on percussion or produce a cracked pot sound
9. Teeth can either be intruded, extruded or subluxated (Figure 7.4).

TRAUMATIC INJURIES TO ANTERIOR TEETH (CLASSIFICATION PROPOSED BY ELLIS)

Class 1. Simple fracture of the crown, involving little or no dentin.

Class 2. Extensive fracture of the crown, involving considerable dentin but not the dental pulp.

Class 3. Extensive fracture of the crown, involving considerable dentin and exposing the pulp.



Figures 7.3A and B

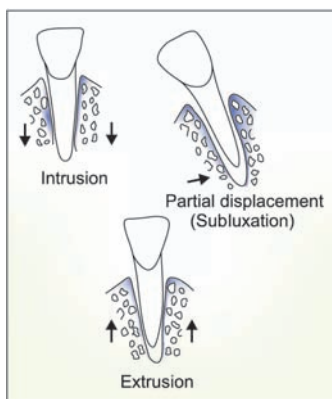


Figure 7.4

Class 4. The traumatized tooth becomes nonvital, with or without loss of crown structure

Class 5. Teeth lost as a result of trauma

Class 6. Fracture of the root, with or without loss of crown structure.

Class 7. Displacement of a tooth, without fracture of crown or root.

Class 8. Fracture of the crown en masse and its replacement

Class 9. Traumatic injuries to deciduous teeth.

CLASSIFICATION OF INJURIES TO TEETH (PROPOSED BY BENNET, 1963)

Class –I Traumatized teeth without coronal or root fracture

- a. Tooth firm in the alveolus
- b. Tooth subluxed in the alveolus

Class –II Coronal fractures

- a. Involving enamel
- b. Involving enamel and dentine

Class –III Coronal fractures with pulpal exposure

Class –IV Root fracture

- a. Without coronal fracture
- b. With coronal fracture

Class- V Avulsion of teeth

Zygomatic Complex Fractures

Signs and Symptoms

1. Flattening of the cheek bone
Stand behind the patient and view the cheek bones bilaterally from above
2. Circum orbital ecchymosis
3. Damage to the Infraorbital nerve or Zygomaticofacial and Zygomaticotemporal nerves (Patient may have anesthesia of the temple, cheek, one side of the upper lip and the nose on the side involved)
4. Interference with mandibular movements. (Inward displacement of the zygomatic bone leads to impingement on the coronoid process thereby leading to interference in the movement of the mandible).
If trauma was sustained when the mouth was widely open then the patient cannot close the mandible, and if the mouth was close then the patient is unable to open his mouth. Lateral excursions to the affected side are not possible.
5. Diplopia caused by involvement of the extraocular muscles or to nerves supplying these muscles
6. Enophthalmos (injury may cause fracture of the orbital walls leading to increase in volume of the orbit which results in inward sinking of the eye.)
7. Ecchymosis in the upper buccal sulcus close to the zygomatic buttress
8. Region of the zygomatic buttress is tender on palpation
9. When only the zygomatic arch is fractured there is depression over the zygomatic arch region and lateral excursion of the mandible to the injured side is impeded (the zygomatic arch impinges on the coronoid process) (Figure 7.5).

Nasal Complex Fractures

Signs and Symptoms

1. Bilateral circum orbital ecchymosis (prominent on the medial aspect of the nose)
2. Subconjunctival ecchymosis confined to the medial half of the eyes
3. Based on the site of the impact the nose can be either deviated to one side (lateral injury) or saddle type depression of the bridge of the nose (anterior impact)
4. Nasal bleeding
5. Patient reports of a salty taste if there is a cerebrospinal fluid leak (comminution of ethmoidal bone)
6. Mobility and acute tenderness of the nasal bones on palpation

Orbital Floor Fractures

Signs and Symptoms

1. Oedema and circum orbital and subconjunctival ecchymosis
2. Proptosis of the affected eye
3. Paraesthesia in the region of supply of the infraorbital nerve
4. Diplopia, mainly during upward gaze

Le Fort I Fractures (Figures 7.6A and B)

The fracture extends from the nasal septum to the lateral pyriform rims, travels horizontally above the teeth apices, crosses below the zygomaticomaxillary junction, and traverses the pterygomaxillary junction to interrupt the pterygoid plates.

Signs and Symptoms

1. Swelling of the upper lip
2. Presence of ecchymosis in the buccal sulcus beneath each zygomatic arch
3. Derangement of occlusion
4. Mobility of maxillary teeth

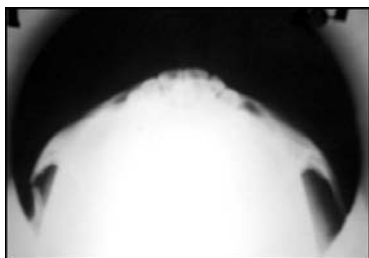


Figure 7.5: 'Jug handle view' showing zygomatic arch fracture



Figure 7.6

5. Maxillary teeth may be grasped firmly and moved to evaluate any impacted type of fracture
6. When upper teeth are percussed they produce a distinctive "cracked-pot" sound.

Le Fort II Fractures

Extends from the nasal bridge at or below the nasofrontal suture through the frontal processes of the maxilla, inferolaterally through the lacrimal bones and inferior orbital floor and rim through or near the inferior orbital foramen, and inferiorly through the anterior wall of the maxillary sinus; it then travels under the zygoma, across the pterygomaxillary fissure, and through the pterygoid plates.

Signs and Symptoms (Figure 7.7)

1. Gross oedema of the soft tissues over the middle third of the face (moon-face appearance)

2. Bilateral circum orbital ecchymosis and subconjunctival hemorrhage
3. Step deformity evident at the infraorbital margins
4. Mobility of the segment of bone at the nasal bridge and infraorbital margins
5. Paraesthesia or anesthesia of the cheek
6. Nasal bones are intact
7. Hematoma of the palate, and buccal sulcus opposite the 1st and 2nd molars bilaterally
8. Anterior teeth do not meet (retropositioning of the maxilla)
9. Possibility of diplopia and limitation of orbital movement in the upward direction
10. Area over the zygomatic bone and arch is practically non-tender
11. When upper teeth are percussed they produce a distinctive "cracked-pot" sound
12. Difficulty in opening the mouth and lateral excursions are rarely limited
13. Bleeding from the nose

Le Fort III Fractures

These fractures begin at the nasofrontal and frontomaxillary sutures and extend posteriorly along the medial wall of the orbit through the nasolacrimal groove and ethmoid bones. The fracture continues along the floor of the orbit along the inferior orbital fissure and continues superolaterally through the lateral orbital wall, through the zygomaticofrontal junction and the



Figure 7.7



Figure 7.8

zygomatic arch. Intranasally, a branch of the fracture extends through the base of the perpendicular plate of the ethmoid, through the vomer, and through the interface of the pterygoid plates to the base of the sphenoid.

Signs and Symptoms (Figure 7.8)

1. Gross oedema of the soft tissues over the middle third of the face (moon-face appearance)
2. Bilateral circum orbital ecchymosis and subconjunctival hemorrhage
3. Tenderness over the frontozygomatic suture
4. Zygomatic arches are deformed and tender on palpation
5. "Dish faced" deformity with lengthening of the face
6. Lowering of the ocular level
7. Step deformity in the infraorbital margin with enophthalmos
8. Tilting of occlusal plane with gagging on one side only
9. Lateral displacement of the midline of the upper jaw
10. Mobility of the whole of the facial skeleton as a single block
(Finger and thumb of one hand are placed over the frontonasal suture region and the dentoalveolar portion of the upper jaw is grasped with the other hand and the movement can be evaluated)
11. When upper teeth are percussed they produce a distinctive "cracked-pot" sound
12. Cerebrospinal fluid rhinorrhoea (patient may occasionally complain of a salty taste in the mouth)

Fractures of the Mandible (Figure 7.9)

1. Dentoalveolar
2. Condylar
 - a. Unilateral
 - b. Bilateral
3. Coronoid
4. Ramus
5. Angle
6. Fracture of the Body (region near the molars and premolars)
7. Symphyseal and Parasymphyseal Fracture

Dentoalveolar Fracture

As the name implies these fractures should involve the teeth (avulsion, subluxation or fracture) and the fracture of the alveolus.

Signs and Symptoms

Similar to dentoalveolar fracture introducing the maxilla.

*Condylar Fractures (most common of all fractures involving the mandible)**Signs and Symptoms*

1. Bleeding from the ear on the side of fracture (laceration of anterior wall of the external auditory meatus).
2. Swelling over the temporomandibular joint area.

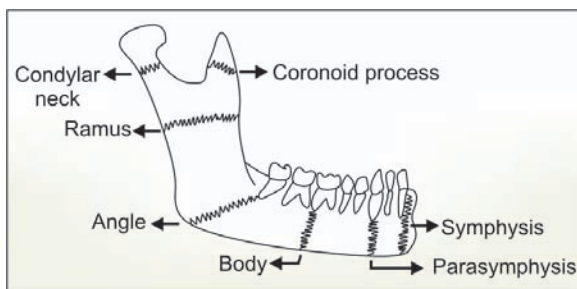


Figure 7.9

3. Ecchymosis of the skin just below the mastoid process on the side of fracture (similar sign is seen in the base of skull fractures, which is referred to as Battle's sign).
4. Tenderness over the condylar region.
5. Paraesthesia of the lower lip is very rarely seen.
6. Gapping of the occlusion on the ipsilateral molar teeth.
7. Deviation of the mandible towards the side of fracture.
8. Limitation of protrusion and lateral excursion to opposite side.
9. Long standing cases of untreated condylar fractures reveal a hollow area over the condylar head region on palpation.

Coronoid Fractures

Caused by a direct impact over the ramus

1. Tenderness over the anterior part of the ramus
2. Hematoma over the region
3. Difficulty in protrusion of the mandible.

Ramal Fractures

1. Swelling and ecchymosis over the region of trauma
2. Tenderness over the ramus of the mandible
3. Severe trismus.

Fractures of the Angle of the Mandible

1. Swelling and tenderness over the suspected site of fracture
2. Anesthesia or paraesthesia of the lower lip
3. Mandibular movements might be painful
4. Step deformity is evident on palpation
5. Intraorally step deformity is often seen distal to the last molar tooth
6. Hematoma in the lingual/buccal vestibule
7. Crepitus at the site of fracture can be elicited

Fracture of the Body of the mandible

1. Swelling and tenderness over the suspected site of fracture
2. Derangement of occlusion

3. Multiple gingival tears
4. Intraoral hematoma (damage of the inferior dental artery)
5. Vertical fracture of molar teeth

Fracture of the Symphysis and Parasymphysis

1. Always check for associated condylar fractures (usually contralateral side)
2. Generally the fractures at these sites are not displaced hence the occlusion is rarely deranged
3. Local bone tenderness and lingual hematoma
4. Rarely causes paraesthesia unless the mental nerve is damaged.

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Evaluation of Lymph Nodes of the Head and Neck Region

Normal nodes are generally difficult to palpate. Enlarged nodes usually indicate past inflammatory processes, a present infection, or a neoplastic process. An adult human has about 400 to 450 lymph nodes in the body. The head and neck region approximately consists of 60-70 nodes. The amount of lymphoid tissue present is proportionately greater in infancy and childhood than in the adult and tends to decrease with old age.

LYMPH NODES OF THE HEAD AND NECK REGION

Lymph nodes in the head and neck region are arranged into two rings.

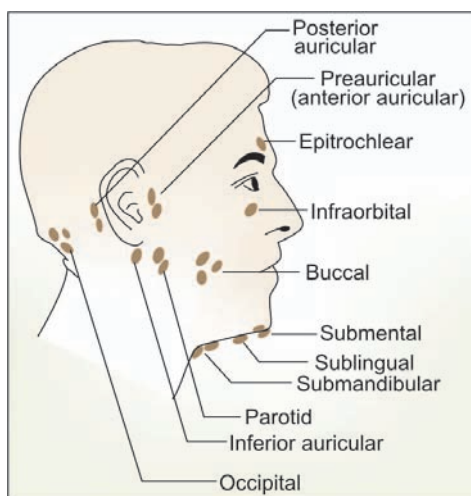
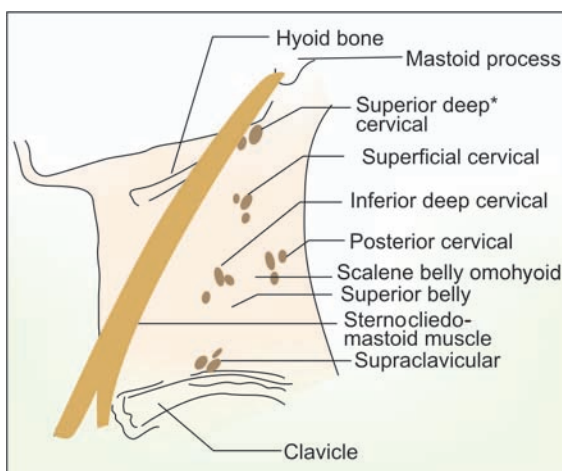
- a. Outer and superficial circle of lymph nodes
- b. Inner and deep circle of lymph nodes

OUTER AND SUPERFICIAL CIRCLE OF LYMPH NODES (FIGURES 8.1 AND 8.2)

Occipital nodes, retroauricular (posterior auricular), preauricular, superficial cervical nodes, submental, submandibular, buccal nodes, jugulo digastric and jugulo omohyoid nodes are part of the outer and superficial rings of lymph nodes.

INNER AND DEEP CIRCLE OF LYMPH NODES

The inner and deep circle of nodes consists of pretracheal, paratracheal and retropharyngeal lymph nodes. The supra

**Figure 8.1****Figure 8.2**

clavicular lymph nodes are the posteroinferior group of the deep cervical nodes.

Examination of the Lymph Nodes of the Head and Neck Region

Patient should be instructed to remove clothing around the face and neck such as scarves and caps. The clavicular region should be exposed.

Examination of Lymph Nodes

Examination of lymph nodes can be accomplished by inspection and palpatory methods.

Inspection

1. Inspect the normal anatomic locations of lymph nodes for any obvious enlargements of nodes.
2. If the nodes are obviously enlarged describe the location, the approximate dimension and number of nodes.
3. Look for any surface changes such as ulcerations or discharge from the site.

Palpation

Most of the lymph nodes are best palpated with the clinician standing behind the patient who is seated on a dental chair.

Palpation of the lymph nodes is ideally done commencing from the most superior lymph nodes and then working down to the clavicle region.

Nodes are palpated to assess whether they are tender or nontender, the consistency and size. The fixity of the node to the underlying structures should also be assessed.

Preauricular nodes (Figure 8.3): They are palpated anterior to the tragus of the ear.

Posterior auricular nodes (Figure 8.4): Palpated at the mastoid process.

Occipital nodes (Figure 8.5): They are palpated at the base/lower border of the skull.



Figure 8.3



Figure 8.4



Figure 8.5

Submental Nodes (Figure 8.6): Submental nodes are palpated under the chin. The clinician can stand behind the seated patient to palpate the submental nodes. The patient is instructed to bend his/her neck. (This helps in relaxing the muscles and fascia of the neck). Fingers of both the hands can be placed just below the chin, under the lower border of the mandible and the submental lymph nodes should be attempted to be cupped within the fingers of both the hands.

Submandibular nodes (Figure 8.7): Submandibular nodes are palpated at the lower border of the body of the mandible approximating the angle.

To examine the lymph nodes of the submandibular region, the patient is instructed to passively flex the neck towards the side that is being examined. This maneuver helps in relaxing the muscles and fascia of the neck, thereby enabling the nodes to be examined easily.



Figure 8.6



Figure 8.7

The fingers of the palpating hand should be kept together to prevent the nodes from slipping in between the palpating fingers. The palmar aspect of the fingers is pushed into the soft tissues below the mandible near the midline. The clinician should then move his fingers laterally to draw the nodes outwards and trap them against the lower border of the mandible. This technique also facilitates the assessment of mobile nodes that can be felt moving over the lower border of the mandible from the medial to the lateral aspect.

Anterior Superficial cervical group of nodes (Figure 8.8).

Lie over the sternomastoid muscle.

Deep cervical nodes:

Lie below the sternomastoid muscle and over the cervical fascia

Posterior superficial cervical nodes:

Palpated in the posterior triangle of the neck close to the anterior border of the trapezius muscle.



Figure 8.8

Examination of the cervical nodes can be accomplished by instructing the patient to hyperextend the neck and turn the neck away from the side to be examined. This position distends

the sternocleidomastoid muscle and facilitates the easier examination of the lymph nodes of the anterior and posterior cervical chains. Fingertips of the palpating hand are placed along the posterior border of the muscle while the thumb provides counter pressure from the anterior aspect of the muscle. Medial pressure of the fingertips along the posterior muscle border helps to assess the nodes of the posterior superficial cervical chain.

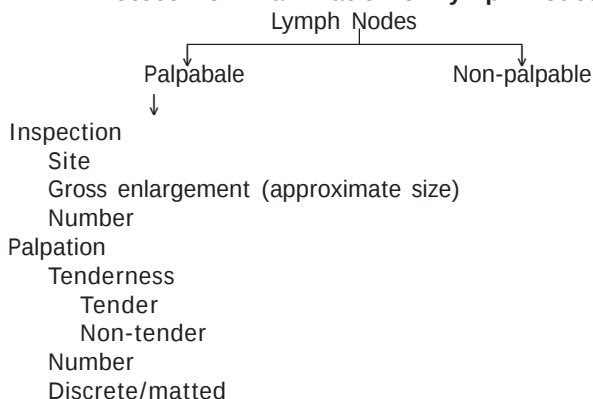
Supraclavicular nodes (Figure 8.9):

Supraclavicular nodes are examined just above the clavicle, lateral to the attachment of the sternomastoid muscle. The supraclavicular nodes are palpated in the supraclavicular fossa. The supraclavicular fossa can be palpated standing in front of the patient. However in some instances when the nodes cannot be felt, the clinician can palpate the supraclavicular fossa bilaterally standing behind the patient. The patient can be instructed to elevate and hunch his/her shoulders forward.



Figure 8.9

Protocol for Examination of Lymph Nodes



Consistency

Soft

Firm

Rubbery

Stony hard

Fixity to underlying structures

Approximate size (for TNM staging)

Table 8.1: Lymphatic drainage of the structures of the head and neck

Structure	Draining lymph node	Drains further into
Maxilla		
Upper jaw including teeth, gingivae and palate	Submandibular nodes	Deep cervicals
Lateral part of the hard palate	Retro pharyngeal nodes	-
Mandible		
Anterior part of the mandible, gingivae, incisor teeth and the chin	Submental nodes	Directly to deep cervicals Or To submandibular and then to deep cervicals
Lower jaw, remaining teeth and gingivae	Submandibular nodes	Deep cervicals
Tongue		
Tip of the tongue	Bilaterally to submental nodes	Lymph from all regions of the tongue eventually drains into the deep cervicals and jugulo omohyoid lymph nodes
Anterior 2/3 rd of the tongue	Unilaterally to submandibular nodes	
Lateral portions	Bilaterally to submandibular nodes	
Midline	Bilaterally to jugulo omohyoid lymph nodes	
Posterior 1/3 rd of the tongue	Bilaterally to jugulo omohyoid lymph nodes	
Lips		
Upper lip	Submandibular nodes	Upper internal jugular nodes
Some areas of the upper lip	Superficial cervical	Deep cervicals
Middle parts of the lower lip	Submental lymph nodes	Directly to deep cervicals Or To submandibular and then to deep cervicals
Lateral parts of the lower lip	Submandibular nodes	Upper internal jugular nodes

Contd...

Contd...

<i>Structure</i>	<i>Draining lymph node</i>	<i>Drains further into</i>
Floor of the mouth		
Anterior part of the floor of the mouth	Submental lymph nodes	Directly to deep cervicals Or To submandibular and then to deep cervicals
Remaining areas of the floor of the mouth	Submandibular nodes	Deep cervical lymph nodes
Cheeks and buccal mucosa		
	Submandibular nodes, Parotid and sometimes directly to superficial upper deep cervical group of lymph nodes	Deep cervical lymph nodes
Salivary glands		
Parotid	Parotid nodes	
Submandibular	Mainly to deep cervical nodes, rest to submandibular lymph nodes	
Sublingual gland (anterior part)	Submandibular lymph nodes	Deep cervical lymph nodes
Sublingual gland (posterior part)	Upper deep cervical lymph nodes	
Tonsils nose		
Extrernal and anterior part of the nose	Jugulo digastric lymph nodes	-
Root of the nose and adjacent parts of the upper eyelids	Submandibular nodes	Deep cervical lymph nodes
Posterior part of the nasal cavity	Parotid nodes	-
	Upper deep cervical and Retropharyngeal group of lymph nodes	-
Paranasal sinuses		
Maxillary Sinus	Still not clear if the maxillary sinus has an external lymphatic drainage. It probably drains into the submandibular lymph nodes	-
Frontal and Ethmoidal sinus	Submandibular lymph nodes	-
Sphenoidal sinus	Retropharyngeal lymph nodes	

Contd...

Contd...

<i>Structure</i>	<i>Draining lymph node</i>	<i>Drains further into</i>
Eyes		
Eye lids and conjunctiva	Parotid and Submandibular lymph nodes	Deep cervical lymph nodes
Orbit and its contents	Preauricular lymphnodes	Deep cervical lymph nodes
Lacrimal gland	Submandibular lymph nodes	Deep cervical lymph nodes
Ear		
External ear (auricle)	Pre auricular and mastoid lymph nodes	Chain of nodes along the external jugular vein
Middle ear	Parotid and retropharyngeal lymph nodes	
Lateral surface of the ear	Parotid nodes	Deep cervical lymph nodes
Scalp		
Anterior portion of the scalp	Submandibular lymph nodes	Deep cervical lymph nodes
Remaining portion of the scalp	Occipital, parotid and mastoid lymph nodes	Deep cervical lymph nodes

CERVICAL LYMPHADENOPATHY

Lymph nodes may be enlarged even though the patient does not complain of any symptom. This is because the disease is either in a clinical stage or has passed its active stage and is resolving. Enlarged lymph nodes in the neck is referred to as cervical lymphadenopathy.

Causes for Cervical Lymphadenopathy (Adapted from Dental Update 2000, Crispian Scully and Stephen Porter)

Inflammatory Infective Causes

Local causes

Bacterial: Local infections in the head and neck region (periapical infections, pericoronitis, cellulitis, osteomyelitis)

Viral: Herpes simplex, Herpes zoster, Herpangina and Rubella

Systemic causes

Bacterial: syphilis, tuberculosis, cat scratch disease and brucellosis

Viral: infectious mononucleosis, cytomegalovirus infections, HIV

Protozoal: toxoplasmosis, leishmaniasis

Other conditions: Mucocutaneous lymph node syndrome (Kawasaki's disease)

Inflammatory Non-Infective Causes

Sarcoidosis

Crohn's disease

Connective tissue diseases

Neoplastic Causes

Primary

Leukaemias

Lymphomas

Secondary

Metastasis from sites in the drainage area of the lymph nodes (Figure 8.10).

Other Causes

Drugs such as Phenytoin



Figure 8.10

LYMPH NODES IN ACUTE INFLAMMATORY CONDITIONS

There is an increase in the volume of lymph flowing through the main efferent lymphatics draining an acutely inflamed site.

The nodes are enlarged, tender and firm on palpation. In some cases the node might become fluctuant if pus has formed within it.

LYMPH NODES IN CHRONIC INFLAMMATORY CONDITIONS

The lymph nodes in chronic inflammatory conditions are enlarged, generally painless unless secondarily infected. They become firm on palpation due to fibrotic changes. In some instances the nodes will coalesce together and become adherent to the adjacent soft tissues and overlying skin. In tuberculosis however because of a chronic abscess formation, the node can become soft and fluctuant and in some cases can show evidence of ulceration.

LYMPH NODES IN NEOPLASTIC DISEASE

Primary Tumors of Lymphatic Tissue

Primary tumors affecting the lymphatic system can be grouped into three categories

1. Lymphatic Leukemia
2. Hodgkin's disease/lymphoma
3. NonHodgkin's lymphoma

Lymphatic Leukemia

Acute Lymphoblastic Leukemia

Generally occurs in children. It represents one of the most commonest childhood malignancies. The clinical features are as a result of infiltration of leukemic cells into other organs and tissues. Because of abnormally functioning leukocytes, infections are frequent complications.

Clinical presentation

1. Pallor, shortness of breath and easy fatigability are common presenting features (Secondary to anemia due to leukemic infiltration in bone marrow)
2. Spontaneous bleeding, ecchymosis, epistaxis, melena, menstrual bleeding and gingival bleeding are seen as a result of thrombocytopenia (especially when the platelet count falls below $25,000/\text{mm}^3$)

3. Fever is a common sign. Fever is seen because of recurrent infections of the lungs, urinary tract, skin, mouth, rectum and upper respiratory tract (because of decreased WBC production).
4. Splenomegaly and Hepatomegaly
5. Cranial nerve palsy, paresthesia, anesthesia, and paralysis is seen when the cells infiltrate the central nervous system.
6. Localized tumors consisting of leukemic cells called Chloromas are seen. (Surface of these tumors turn green when exposed to light because of the presence of myeloperoxidase)

Chronic Lymphocytic Leukemia

It is the most common type of Leukemia. It primarily affects adults over the age of 40 years. It has a slow course, as such the disease generally goes undetected until any clinical signs and symptoms are apparent. The asymptomatic phase of the disease lasts for years, but eventually signs and symptoms of the infiltration of the leukemic cells in the bone marrow, lymph nodes and other tissues appear.

Clinical Presentation

1. Cervical lymphadenopathy and enlargement of the tonsils are frequent signs.
2. Anemia and Thrombocytopenia resulting from bone marrow infiltration cause pallor, weakness, purpura and dyspnea.
3. Infiltration into other tissues causes lymphadenopathy, splenomegaly and hepatomegaly
4. In the advanced stages of the disease, the massive lymphadenopathy may cause intestinal or urethral obstruction and obstructive jaundice.

Oral Manifestations and Dental Considerations

Since most patients present with oral findings the dentist may play a major role in diagnosing the disease during a routine dental evaluation.

Cervical lymphadenopathy, bleeding from the oral tissue, gingival bleeding, recurrent oral infections and ulcers involving the oral mucosa are common findings.

Bleeding from the Oral Mucosa/Gingival Bleeding

Spontaneous gingival bleeding occurs when the platelet count falls below 25,000 cells/mm³. The extent of the bleeding from the gingiva depends upon the amount of local irritants and the severity of thrombocytopenia.

Management

1. Removal of local irritants.
2. Direct pressure using absorbable gelatin or collagen sponges.
3. Application of topical thrombin.
4. Oral rinses containing antifibrinolytic agents such as tranexamic acid or epsilon amino caproic acid (EACA).
5. Platelet transfusion is usually the last modality of managing oral/gingival bleeding.

Ulcers Involving the Oral Mucosa

Oral ulcers can occur as a result of bacterial invasion secondary to neutropenia or as a result of direct effects of the chemotherapeutic drugs used for treating leukemia.

The ulcers are large, have irregular margins and associated with a foul odor. These ulcers are generally surrounded by pale mucosa (as a result of anemia and lack of normal inflammatory response).

Management

1. Topical antibacterial agents such as Povidone Iodine
2. Chlorhexidine mouth rinses

Oral Infection

Oral candidiasis is the most common fungal infection that affects patients with leukemia. Diagnosis of oral infections specifically periapical, pericoronal and periodontal infections is difficult in neutropenic leukemic patients as they lack a normal inflammatory response.

Management: The oral physician should conduct a thorough evaluation of the patient and eliminate all potential sources of acute infection or bacteremia before the patient is subjected to chemotherapy for leukemia. In some cases intravenous combinations of antibiotics and platelet transfusion may be required before commencement of any invasive dental treatment.

Hodgkin's Disease /Lymphoma

Hodgkin's disease is classified as a malignant lymphoproliferative disorder though the exact nature of the disease process is poorly understood. Hodgkin's lymphoma is about 1/6th common as non-Hodgkin's lymphoma. Neoplastic cells (reed sternberg cells) make up about 1 to 3% of the cells in the enlarged lymph nodes that characterize Hodgkin's disease.

Types of Hodgkin's Lymphoma

1. Nodular lymphocyte—predominant Lymphoma
2. Classical Hodgkin's lymphoma
(Five histopathologic subtypes):
 1. Lymphocyte rich
 2. Nodular sclerosis
 3. Mixed cellularity
 4. Lymphocyte depletion
 5. Unclassifiable

Clinical Features

1. The disease process almost always begins in the lymph nodes
2. Cervical and supraclavicular nodes are the most commonly involved (70–75%). Axillary and mediastinal nodes (5-10%), and the least involved are the abdominal and inguinal nodes (less than 5%).
3. Males are more commonly affected
4. A bimodal pattern is observed with regards to the age of the patient who is diagnosed as having Hodgkin's disease. One peak is seen between 15 and 35 years of age. Another peak is observed after 50 years of age.

5. Initially only one group of lymph nodes are involved. The lymph nodes are persistently enlarging, nontender on palpation. In this stage the lymph nodes are generally mobile.
6. With the progression of the disease process more groups of lymph nodes are involved. The lymph nodes become matted and get fixed to the underlying structures.
7. In untreated cases spleen, and other extralymphatic tissues such as the bone, liver and lungs are affected.
8. Oral cavity is rarely involved
9. Patient may present with other systemic signs and symptoms such as weight loss, night sweats, pyrexia and generalized pruritis.

Clinical Staging of Hodgkin's Lymphoma

Category A- Patients who do not have systemic signs and symptoms

Category B- Patients who have systemic signs and symptoms.

It is considered that patients who do not have the systemic signs of weight loss, night sweats, pyrexia and generalized pruritis have a better prognosis.

Ann Arbor System of Classification for Hodgkin's Lymphoma

Stage I - Involvement of a single lymph node region

I_E - Involvement of a single extra lymphatic site or organ

Stage II- Involvement of two or more lymph node regions on the same side of the diaphragm

II_E - One or more lymph node regions with an extra lymphatic system site

Stage III- Involvement of lymph node regions on both sides of the diaphragm.

III_E - involvement of an extralymphatic site or organ

III_s - Involvement of spleen

III_{SE} - Involvement of an extralymphatic organ or site + involvement of the spleen

Stage IV- Diffuse or disseminated involvement of one or more extralymphatic organs with or without associated lymph node involvement.

Non-Hodgkin's Lymphoma

Non-Hodgkin's lymphoma includes a diverse and complex group of malignancies affecting the lymph reticular histogenesis. They usually arise within the lymph nodes and tend to grow as solid masses. Non-Hodgkin's lymphomas arise from the cells of the B-lymphocyte series.

In 1980 a classification system was devised for Non-Hodgkin's lymphomas. This was called the "Working Formulation for Clinical Use."

Based on this classification system non-Hodgkin's lymphomas can be categorized as

1. Low grade
2. Intermediate grade
3. High grade

However as the Working Formulation classification has shown to be limited in its ability to categorize all disease processes, in the year 1990, Revised European-American Lymphoma (REAL) classification was proposed. In the REAL system, a combination of histopathologic features, immunologic cell surface markers and gene rearrangement studies are used to categorize various forms of non-Hodgkin's lymphoma.

REVISED EUROPEAN-AMERICAN LYMPHOMA (REAL) CLASSIFICATION

B-Cell Neoplasms

I. Precursor B-cell Neoplasms

Precursor B-lymphoblastic leukemia/lymphoma

II: Peripheral B-cell Neoplasms

B-cell chronic lymphocytic leukemia/prolymphocytic leukemia/small lymphocytic lymphoma

Lymphoplasmacytoid lymphoma/immunocytoma

Mantle cell lymphoma

Follicle center lymphoma, follicular

Marginal zone B-cell lymphoma

Provisional entity: splenic marginal zone lymphoma

Hairy cell leukemia
 Plasma cytoma/plasma cell myeloma
 Diffuse large B-cell lymphoma
 Burkitt's lymphoma
 Provisional entity: diffuse large B-cell lymphoma, Burkittlike

T Cell and Putative NK Cell Neoplasms

- I. Precursor T – cell Neoplasms
 - II: Peripheral T – cell Neoplasms
 - T- cell chronic lymphocytic leukemia
 - Large granular lymphocytic leukemia
 - Mycosis fungoides/Sezary syndrome
 - Peripheral T-cell lymphoma Unspecified
 - Angio immunoblastic T-cell lymphoma
 - Angiocentric lymphoma
 - Intestinal T-cell lymphoma
 - Adult T-cell lymphoma/leukemia
 - Anaplastic large cell lymphoma
 - Provisional entity: anaplastic large-cell lymphoma, Hodgkin's like

Clinical Presentation

1. Generally seen in adults. However, the aggressive intermediate and high grade lymphomas occur in children.
2. Primarily affects lymph nodes. Extranodal involvement is also seen
3. Slowly enlarging nontender mass. Generally affects one group of lymph nodes such as the axillary, inguinal or cervical group.
4. Initial stages show freely moving nodes, as the disease progresses the nodes become numerous and are attached to underlying structures.

Oral Manifestations

The malignancy may present either in the oral soft tissues or as a central lesion within the jaws.

Soft tissue lesions

1. Soft tissue lesions appear as soft non- tender swellings, commonly seen in the buccal vestibule, gingiva and posterior part of the hard palate.
2. These swellings may appear purplish or erythematous and have a boggy appearance. They may be ulcerated.
3. Denture wearers may report of an ill -fitting denture or a denture that has suddenly become too tight.

Bone lesions

1. Patient complains of a vague pain in the bone that may mimic toothache
2. Lymphomas in the mandible may cause paresthesia
3. Untreated lesions will result in expansion of the cortical plates and ultimately lead to cortical plate perforation.
4. These lesions may cause an overlying swelling of the soft tissue mimicking a dentoalveolar abscess.

METASTASIS THROUGH THE LYMPHATIC SYSTEM

Malignant tumors very commonly metastasize through the lymphatic system. In the process of spreading through the lymphatic system they secondarily involve the lymph nodes. In some cases the spread occurs at a microscopic level and hence the nodes may appear normal. In most of the cases the nodes are grossly enlarged. On palpation the nodes are non-tender, stony hard in consistency and usually fixed to the underlying structures. In some cases lymph nodes are tender and ulcerated.

Generally lesions from the oral cavity, maxillary sinus, oropharynx, nasopharynx, larynx and thyroid gland metastasize the regional cervical lymph nodes. Metastasis may also occur from distant sites such as the primary tumors from the gastrointestinal tract, breast and the lungs. Malignant spread from the abdomen and bronchus may affect the supraclavicular nodes on the left side. When the supraclavicular nodes are involved secondary to carcinoma of the stomach, it is referred to as sign of Troisler.



Examination of Temporomandibular Joint

The temporomandibular joint (TMJ) provides the articulation between the movable mandible and the fixed temporal bone of the cranium. TMJ is also referred to as a synovial and ginglymoarthroidal joint (ginglymo-hinge like movement, arthroidal-gliding movement).

The TMJ is capable of a combination of both hinge and sliding movement. These movements are possible because of two independent but functionally related joints within each TMJ. Although the TMJ is composed of only two bones, the mandible and the temporal, the articular disk is considered as a non-ossified third bone interposed between the condyle and articular eminence (Figure 9.1).

Temporo-mandibular joints (TMJ) are located about 1.5 cms anterior to the tragus of the ear. The two TMJ's, considered together, compromise only one part of the total articulation between the lower jaw and the skull-facial skeleton complex. The other important contribution is made by the interdigitation of the mandibular and maxillary dentitions. The function and health of the TMJs is directly related to the condition of the teeth. Abnormal stress may be transferred to the TMJs by malocclusions degenerative changes and by other psychological abnormalities.

Temporo-mandibular disorders have a variety of signs and symptoms, which are based on anatomical, physiological and psychological status of an individual. The myriad of signs and symptoms are related to diseases affecting the TMJ and its related structures.

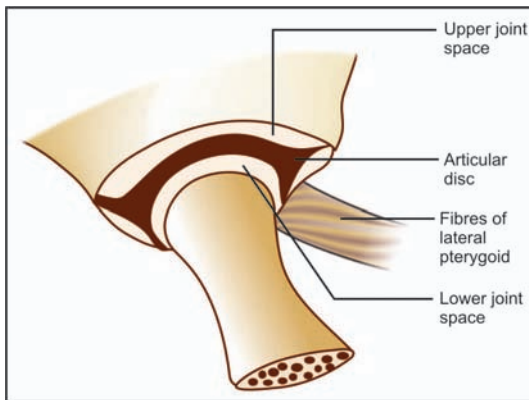


Figure 9.1

The ability of the clinician to make a proper diagnosis is often complicated further by the fact that the pathologic conditions are neither readily visible nor accessible for careful examination. As a result considerable confusion exists in diagnosing temporo-mandibular joint pathology.

FUNCTIONAL ANATOMY

Mandibular movements is achieved by combination of muscle activity along with rotation or translation in the temporo-mandibular joints.

Opening movement: Bilateral contraction of the inferior lateral pterygoid muscles result in opening movements of the mandible.

Closing movement: Bilateral contraction of the masseter, temporalis and medial pterygoid muscles causes mandibular closure.

Protrusive movement: A simultaneous bilateral contraction of the inferior bellies of the lateral pterygoid muscle results in protrusion of the mandible.

Retrusive movement: Mandibular retrusion is accomplished by the temporalis and suprahyoid muscles.

Lateral excursions: Lateral excursions of the mandible are brought about by the lateral pterygoids of the opposite side and the temporalis, which assists the movement.

EXAMINATION OF THE TEMPOROMANDIBULAR JOINT

The history of presenting illness should include the onset and course of signs and symptoms. Past history should include the details regarding arthritis, infections, degenerating diseases, parotitis, ear disorders, muscular disorders, trauma, past dental treatment, diet/nutritional adequacy and habits like clenching, gum chewing, unilateral chewing habit, etc. and the individual lifestyle.

TMJ examination includes:

- i. Examination of TMJ proper
- ii. Examination of muscles of mastication
- iii. Examination of accessory muscles

1. EXAMINATION OF TMJ PROPER

TMJ is examined under three basic headings:

Inspection

Palpation

Auscultation

The clinician can be seated on the side of the patient in a 10 o' clock position and occasionally behind the patient to examine the TMJ.

Inspection

Inspect for an obvious asymmetry of the face (Figure 9.2).

Examine for swelling/ulceration in the pre auricular region.

Observe for deviation/deflection of mandible on mouth opening (Figures 9.3 and 9.4).



Figure 9.2

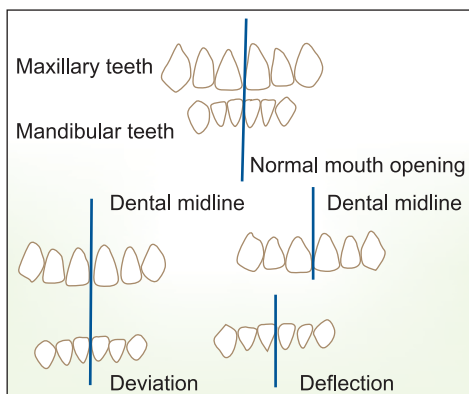


Figure 9.3

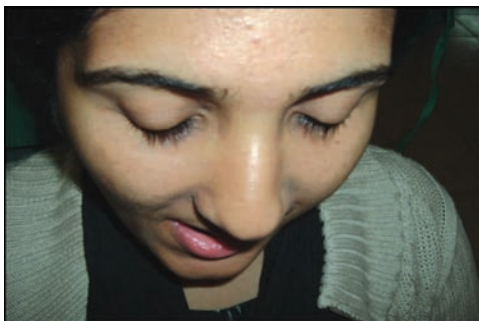


Figure 9.4

Deviation: It is the movement of the mandibular midline to one side in the initial stages of mouth opening and which returns back to the central position at maximal mouth opening. (example: anterior disc displacement with reduction)

Deflection: It is the movement of the mandible completely to one side on mouth opening and fails to return to the midline at maximal mouth opening. (example: anterior disc displacement without reduction).

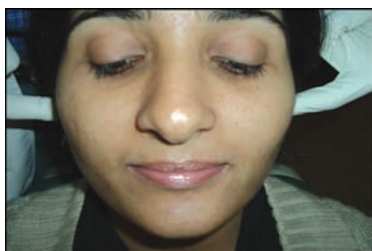
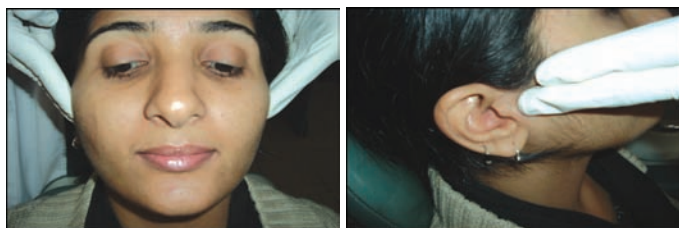


Figure 9.5



Figures 9.6A and B

Palpation

Condyles can be palpated by extra-auricular and intra-auricular methods.

Intra-auricular Examination (Figure 9.5)

The little finger is placed inside the external auditory meatus. During mandibular movement with the pulp of the little finger feel for the condylar movements.

Extra-auricular Examination (Figures 9.6A and B)

Extra-orally condyles can be palpated in the pre-auricular region about 1.5 centimeters medial to the tragus of the ear. (Lateral pole of the condyle is accessible during this examination).

Palpation of the TMJ will reveal pain and irregularities during condylar movement and can be described as clicking or crepitus.

Joint noises and pain may have palpable differences when comparing left to right.

Note whether the noises/ crepitations occurs during

Wide opening

Closing the mouth

Intermediate

Palpate for tenderness of TMJ during

Rest and clenching

Right and left excursion

Protrusion and retrusion

Check for

Hypermobility

Hypomobility

Mouthopening should be measured in

- a. Maximal mouth opening without pain
- b. Maximal mouth opening with pain
- c. Maximal mouth opening with assistance

(Apply mild to moderate pressure against upper and lower anteriors with thumb and index finger criss crossed)-(Figure 9.7)

Normal maximal mouth opening is more than or equal to 40 millimeters

In males: range is from 38.7 to 60.4mm with a mean of 52.8 mm

In females: range is from 36.7 to 60.4 mm with a mean of 48.3 mm

In children: range is from 32 to 64 mm with a mean of 60.4 mm.

A protrusive and lateral movement is more or less than 7 mm.

Check for deviation and deflection.

(Protrusive movement is measured by adding the horizontal distance between upper and lower incisors and adding the distance the lower incisors travel beyond the upper incisors.)

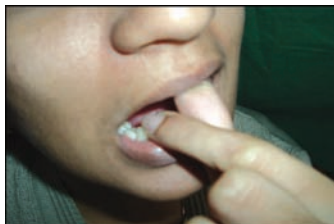


Figure 9.7

The condyle that does not translate may not be palpable during mouth opening and closing.

The click that occurs on opening and closing and that is eliminated by bringing mandible into a protrusive position before opening is most often associated with articular disk displacement with reduction.

Auscultation of TMJ

Joint sounds are examined using a stethoscope. The bell end of the stethoscope is placed over the lateral poles (medial to the tragus of the ear) of the TMJ bilaterally. The commonly heard joint sounds are clicks, popping sounds and crepitus.

Click is a short sharp noise that occurs during opening and closing movement of the mandible. They can be categorized as opening click, closing click and reciprocal click. Like the name suggests opening click is evident during mouth opening. Closing click is felt during mouth closure and reciprocal click is evident both during opening and closing movements of the mandible. Clicks are generally evident in anterior disc displacement with reduction

Popping sound is usually described as a loud noise or 'thud'. It usually occurs at the end of maximal mouth opening. Popping sound is indicative of joint hypermobility.

Crepitus is also described as a grating noise. It is usually associated with degenerative changes in the articular surface of the TMJ.

2. PALPATION OF MASTICATORY MUSCLES

Tenderness of the muscles of mastication results from stress and fatigue which are characteristic of jaw dysfunction.

The methods for palpation is not standardized in clinical examination

The four muscle pairs to be palpated are temporalis, masseter, medial and lateral pterygoids.

Temporalis (Figure 9.8)

Temporalis is palpated simultaneously with the fingertips aligned in a row from the hair line just above the supra-orbital ridge to above the ear.

The patient is asked to report any discomfort or pain.



Figure 9.8

Masseter (Figures 9.9A and B)

Masseter is palpated bilaterally in the area over lying the anterior border of the mandibular ramus. The belly of the masseter is palpated against the ascending ramus of the mandible.

The patient response is recorded.



Figures 9.9A and B

Pterygoid Muscles

Palpation of the pterygoid muscle is difficult because of the inaccessibility of the muscle. The technique is likely to cause discomfort in individuals with out a temporo-mandibular disorder.

Medial Pterygoid (Figure 9.10)

Medial pterygoid can only be palpated near its insertion by placement of the index finger laterally and posteriorly into the

**Figure 9.10****Figure 9.11**

floor of the mouth towards the medial surface of the angle of the mandible.

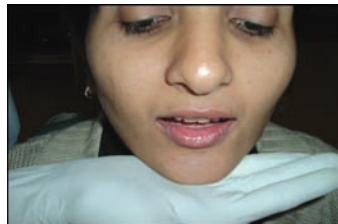
Lateral Pterygoid (Figure 9.11)

Tenderness of the lateral pterygoid can occasionally be detected by indirect application of pressure.

The index finger is positioned distal and posterior to the maxillary tuberosity and posterior pressure is exerted to compress tissue against the muscle. Some clinicians refer to this as pterygoid sign evaluation.

Functional evaluation of the medial and lateral pterygoid muscles can be done by two techniques.

1. Resistance against closure (Figure 9.12)
2. Resistance against mouth opening (Figure 9.13)

**Figure 9.12****Figure 9.13**

3. EXAMINATION OF ACCESSORY MUSCLES DIAGNOSTIC

Diagastric Muscle

Digastric muscles are palpated with the finger tips aligned roughly parallel to the inferior border of the mandible in the sub-mental and sub-mandibular region.

Cervical Examination

Temporo-mandibular disorders/ myofascial pain disorders often have musculoskeletal problems in other regions that are particularly associated with neck.

Check for mobility of the neck and examine for range and symptoms.

Patient is first asked to look to the right and then to the left. There should be at least seventy-degree rotation in each direction. Next patient is asked to look upward as far as possible (extension) and then downward (flexion). Any pain is recorded and any limitation of the movement determines muscular or vertebral problem.

Sternocleidomastoid /trapezius/ posterior cervical muscles are often part of neck disorder and may refer pain to face and head.

Sternocleidomastoid Muscle (Figure 9.14)

Palpation is done bilaterally near its insertion on the outer surface of the mastoid fossa behind the ear. The entire length of the muscle is palpated down to its origin near the clavicle.



Figure 9.14

Posterior Cervical Muscles (Trapezius Longissimus [Capitis Splenius] and Levator Scapulae)

The posterior cervical muscles do not directly affect mandibular movements, however, they do become symptomatic during temporo-mandibular disorders and therefore are routinely palpated.

They originate at the posterior occipital area and extend inferiorly along the cervicospinal region. Because they are layered over each other they are sometimes difficult to identify individually.

In palpating these muscles the examiners fingers slip behind the patient's head. Those of the right hand palpate the right occipital area and those of the left hand palpate the left occipital area, both at the origins of the muscle.(the patient is questioned regarding any discomfort). The fingers then move down the length of the neck muscles through the cervical area and any patient discomfort is recorded.

Trapezius

Trapezius an extremely large muscle of the back, shoulder and neck, does not directly affect jaw function but is a common source of headache, pain and is easily palpated.

Trapezius commonly has trigger points that refer pain to the face and hence the purpose of its palpation is to search for active trigger points. The upper part is palpated from behind sternocleidomastoid, inferolaterally to the shoulder and any trigger points are recorded.

Splenius Capitis

Splenius capitis is palpated for general pain, tenderness, trigger points.

Its attachment to the skull is a small depression just posterior to the attachment of the sternocleidomastoid.

Palpation is begun at this point and moves inferiorly as the muscle blends into the other muscles.

Any pain tenderness, trigger points are recorded.

Occlusal Evaluation

Examining the dentition and occlusion is an important part of the physical examination of a TMJ disorder or orofacial pain patient. It may provide very useful information about the existence of bruxism or



Figure 9.15

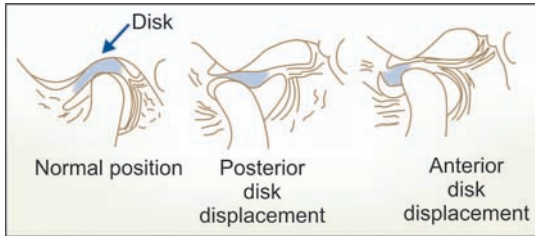
other oral habits and their possible effects on the dentition, periodontium or other oral structures. Such an examination can also determine whether there has been a progressive change in the occlusal relationship (midline shift, anterior open bite, unilateral posterior open bite, etc.) (Figure 9.15) that may indicate the presence of such conditions as unilateral condylar hyperplasia, rheumatoid arthritis, or neoplasm. Noting the number of missing teeth particularly loss of posterior occlusal support is important since this situation may predispose the TMJ's to degenerative joint disease (osteoarthrosis) especially in presence of bruxism.

Beyond those indications the diagnostic validity of association of specific occlusal relationship with temporomandibular disorders are quite poor except for skeletal anterior open bites, overjets of greater than 6 to 7 mm retruded contact positions/ intercuspal position slightly greater than 4 mm, unilateral lingual crossbite and 5 or more missing posterior teeth. Occlusal factors have not been found to be correlated with temporomandibular disorders or orofacial pain. Further more, some of these occlusal conditions may be the result of TMJ abnormality and not the converse. Hence the temporomandibular disorders should be treated with conservative and reversible therapeutic modalities.

COMMON TEMPOROMANDIBULAR DISORDERS

1. Anterior Disk Displacement with Reduction (Figure 9.16)

Common in general population



Figures 9.16 and 9.17

To note that clicking/popping is of little significance unless the clicking is accompanied by pain or unless the patient experiences dysfunction due to intermittent locking.

Observe for:

- Pain during mandibular movement

- Pain noticeable during click

Palpation and auscultation of TMJ will reveal a clicking/popping sound during opening and closing mandibular movements.

Observe for deflection of the mandible early in the opening cycle, with correction towards the midline after the click.

2. Anterior Disk Displacement without Reduction (Closed Lock)

History will be positive for clicking joints, progresses to intermittent locking and then a permanent locking. Patient will have a history of a long standing click that disappears suddenly and sudden restrictions in mandibular opening.

Palpation will reveal decreased translation of the condyle on the side of displacement

Mandible deviates toward the side of displacement during maximal opening.

3. Posterior Disk Displacement (Figure 9.17)

Patient will have a complaint of a sudden inability to bring upper and lower teeth together in maximal occlusion.

Pain in the affected joint when trying to bring the teeth firmly together

Forward displacement of the mandible on the affected side

Restricted lateral movement to affected side

No restriction of mouth opening.

4. Articular surface defects

Defects of the articular surface may be caused by trauma to the mandible (when teeth are not in occlusion), inflammation or physiologic remodelling as a result of overloading of the temporomandibular joint (TMJ). It occurs both in the upper and lower joint compartments of the TMJ.

Clinical findings

- i. It presents as a mechanical dysfunction
- ii. Patient will not have pain
- iii. Mandible deviates (at the point of interference) on mouth opening
- iv. Click is evident (clicks are evident at the same point during opening and closing movements, unlike the clicks associated with disc displacement with reduction where the click rarely occurs at the same point in opening and closing movements of the mandible).

5. Disk thinning and perforation

It is usually seen in older patients as a result of physiologic wearing away of the articular disk. However, it can also be seen to occur as a result of overloading of the joint when teeth are in occlusion. Long standing pressure over the disk surface can result in perforation of the disk.

Clinical findings

- i. Pain is the earliest clinical sign
- ii. Grating sound or crepitus is heard if the disk is perforated
- iii. Alteration in occlusion when teeth are in maximum intercuspation can be seen if the disk is fractured.

Disk thinning or perforation can be assessed by arthrography.

6. Capsulitis/Synovitis

Capsulitis and synovitis are considered a single disease entity as they share similar clinical findings. Capsulitis refers to the inflammation of the outer fibrous layer of the joint capsule. Synovitis is the term used to refer to inflammation of the inner synovial lining.

These conditions may result from prolonged mouth opening, trauma to the TMJ or due to a sprain caused by sudden stretching of the capsular ligament.

Clinical findings

- i. Patient complains of pain during rest which aggravates during jaw movements.
- ii. Limited TMJ movement
- iii. Swelling and tenderness over the affected joint.

Capsulitis or synovitis can be managed with non-steroidal anti-inflammatory drugs (NSAID) and application of moist heat fomentation over the affected joint. Patient can be instructed to limit jaw movement. In severe cases corticosteroids can be injected into and around the TMJ.

7. Osteoarthritis of the TMJ

Osteoarthritis is a degenerative disease affecting the TMJ. It usually tends to be self-limiting. It has been reported that in spite of any active therapy the condition ceases to exist beyond 3 years of time.

Clinical findings

- i. Constant localized pain over the joint
- ii. Pain aggravates on masticatory movement and relieved by rest
- iii. Limited jaw movement
- iv. Lateral pole of the condyle is tender on palpation
- v. Myositis often accompanies osteoarthritis as protective mechanism (prevents excessive jaw movements).

- vi. Radiographs reveal flattening of the condyle formation of osteophytes and a reduction of joint space.

The patient should be educated regarding the self-limiting nature of the disease. He/she should be instructed to consume to soft diet and advised to restrict excessive joint movements.

8. Myositis

Inflammation of muscle is termed myositis. The muscles of mastication are commonly affected. Most cases of myositis are caused as an extension of prolonged periods of muscle splinting (It is a reflexive protective mechanism resulting in muscle stiffness and pain in order to protect the injured part from further trauma). Untreated myositis can lead to fibrous scarring of the involved muscle and muscle contracture.

Clinical findings

- i. The involved muscle will be tender on palpation
- ii. Pain present on rest which exacerbates on TMJ movements.

Myositis can be managed with muscle relaxants and NSAID. Patient can be instructed to limit his mouth opening. Patient should be encouraged to perform jaw exercises along with moist heat application over the affected site.

9. Condylar aplasia

A faulty or incomplete development of the mandibular condyle is referred to as aplasia.

When the clinical findings are evident on only one side the condition is referred to hemifacial microsomia or first and second arch syndrome.

Clinical findings

- i. Reduction in the size of the size of the condyle and ramus

- ii. Inferior displacement of the glenoid fossa and external auditory meatus
- iii. Coronoid process is placed superiorly when compared to the condylar position
- iv. Facial asymmetry associated with canting of lips, deviation of the nose and chin to the affected side.
- v. Canting of the occlusal plane to the defective side
- vi. Agenesis or impaction of permanent teeth on the affected teeth.
- vii. Hypoplasia of the orbits, maxilla, zygoma, salivary glands and muscles of mastication.

10. Condylar hypoplasia

An underdeveloped or partially developed condyle is referred to as a hypoplastic condyle. The causes for this anomaly could be an injury during the development of the mandible, odontogenic infections, forceps delivery, radiation therapy, dietary deficiencies, and endocrinal disturbances.

Clinical findings

- i. Facial asymmetry
- ii. Involved side may show a short and wide condylar process and an elongated coronoid process
- iii. The contralateral side reveals an elongated body of the mandible
- iv. Occlusion shifted to affected side
- v. Molar teeth are generally impacted.

11. Condylar hyperplasia

It is an overdevelopment of the condyle, which may either be developmental or acquired.

The causes for condylar hyperplasia can be trauma, infections, hormonal disturbances and local circulatory disturbances.

Clinical findings

- i. Commonly seen in the 2nd and 3rd decade of life
- ii. Facial asymmetry with the midline shifted to the contralateral side
- iii. Open bite on the affected side



Assessment of Orofacial Pain

Pain is a sensation of suffering resulting from a noxious stimulus, physical disorder, or mental derangement.

Orofacial pain is the single most common complaint that the patient will report with to a dental hospital.

DIFFERENT TYPES OF PAIN

I. Based on onset and duration

Acute pain: It is usually associated with the clinical conditions of rapid onset producing severe symptoms over a short period of time.

Chronic pain: It usually develops slowly and persists over a long period of time.

II. Based on site and origin of pain

1. *Primary pain:* If the source and site are in the same location, the pain is considered to be the primary pain. It is usually not difficult to diagnose because there are often clinical findings that help to explain the complaint.
2. *Heterotopic pain:* If the site of pain is other than that of its source, then it is said to be heterotopic pain. Heterotopic pain can be categorised into projected pain, referred pain and secondary pain.
 - i. *Projected pain:* It is felt in the anatomic peripheral distribution of the same nerve that mediates the primary pain.

- ii. Referred pain: It is felt in an area that is innervated by a nerve different from the one that mediates the primary pain.
- iii. Secondary pain: Heterotopic pain that is induced by deep somatic pain as a central excitatory effect.

CLASSIFICATION OF PAIN BY ITS ORIGIN

A simple categorisation of pain into somatic neurogenous and psychogenic pain was proposed by bell.

Somatic Pain

It is the pain resulting from the noxious stimulation of normal neural structures that innervate the body tissue.

Neurogenous Pain

It is the discomfort generated within the nervous system itself and is caused by an abnormality of the neural structures that innervate the body tissue.

Psychogenic Pain

It is the pain resulting from psychological causes and not from noxious stimulation or neural abnormality.

CLINICAL EVALUATION OF OROFACIAL PAIN

Onset of Pain

- Pain of brief duration suggests acute inflammatory somatic pain and will typically exclude chronic conditions
- Severity of pain depends on the individuals pain threshold.

Localization of Pain

- Somatic pain is generally localized in nature.
- Inability to localize pain may indicate somatic pain originating from deep tissues.

- Referred pain can be distinguished from primary pain by failure to obtain relief by a local anesthetic injection given at the site of pain.

Characteristics of Pain

- Severity of pain can be graded as mild, moderate or severe
- Descriptive terms may be used such as steady, bright, pricking, dull, itching, vague aching, sharp or pounding, lancinating, throbbing, etc.
- Acute pulpitis is usually severe compared to pain from periodontal diseases
- Pain from acute pulpitis may be described as severe lancinating and disrupts the routine activity. Pain usually increases during sleep
- Pain from periodontal disease is usually dull, throbbing and may not disrupt the routine activities

Course of Pain

- Episodic pain (neural origin) is classified as intermittent in contrast to continuous
- Steady increase of pain is typical of the progressive, acute infection produced by bacterial infections.
- Periods of pain followed by recurrences is a pattern of pain often caused by chronic inflammatory lesions that episodically undergo acute exacerbation
- Spontaneous pain suggests, it may be neurogenic, psychogenic or caused by severe inflammation
Certain painful conditions exhibit a particular pattern of onset. For example:
- Painful sequelae of nocturnal bruxism is more severe in the morning
- Tension headaches are relatively constant throughout the day.

Factors that Alter Pain

- Alterations of pain following exposure to certain agents and conditions can reveal its nature and possible causes

- Application of ice, for example, soothes pain from most superficial inflammatory causes and moist heat usually relieves the deeper discomfort of muscle spasms.

Associated Findings

- Pain associated with fever, fatigue, pus discharge usually suggests inflammatory origin or bacterial infection
- Uremia, electrolyte imbalance and variety of medications can accentuate the pain perception
- Emotional stress may exacerbate somatic pain or suggest psychogenic component.

Medical History

- Current, pre-existing relevant physical disorder or disease (specifically systemic arthritides, or other musculoskeletal, rheumatologic conditions)
- Previous treatments, surgeries and/or hospitalizations
- Medications
- Allergies
- Alcohol and other substance of abuse.

Dental History

- Current or pre-existing relevant physical disorders or disease.
- Previous treatments, including patients attitude towards the treatment
- History of trauma to the head and neck (including the iatrogenic trauma)
- Parafunctional history (both diurnal and nocturnal).

Psychosocial History

- Social, behavioral and psychological status
- Occupational, recreational, and family history
- Litigation, disability

PHYSICAL EXAMINATION

1. General inspection of the head and neck
Note any asymmetry, posture and involuntary movement.
2. Evaluation of the associated muscles, TMJs and Cervical spine.
Palpate the muscle of mastication and cervical muscles.
Palpate the TMJ intrameatally and preauricularly. Measure range of motion, quality of movement and association with pain.
Auscultate and palpate for joint noises in all movements.
Guide mandible movement noting pain, end feel and joint noises in all movements.
Note any tenderness, swelling, enlargements.
3. Neurological Evaluation
Conduct cranial nerves examination.
4. Ear, nose and throat evaluation.
Inspect the ears and nose for pathology, discharge, swelling and enlargement.
Inspect the oropharynx for pathologic changes.
5. Evaluate salivary glands and maxillary sinus

Intraoral Evaluation

Examine hard and soft tissues of the oral cavity. Evaluate for carious lesions, wasting diseases, tooth mobility and trauma.

Assess gingival and periodontal status and other pathologic alterations of the soft tissues.

CLINICAL CHARACTERISTICS OF PAIN

Based on the origin, orofacial pain can exhibit various clinical features. This can enable the physician to diagnose the basis for pain.

Clinical Characteristics Displayed by Superficial Somatic Pain

- The pain has a bright, stimulating quality.

- Subjective localization of the pain is excellent and anatomically accurate.
- The site of pain identifies the correct location of its source.
- Response to provocation at the site of pain is faithful in incidence, intensity and location.
- The application of topical anesthesia at the site of pain temporarily arrests it.

Clinical Characteristics Displayed by Deep Somatic Pain

- The pain has a dull, depressing quality.
- Subjective localization of the pain is variable and somewhat diffuse.
- The site of pain may or may not identify the correct location of its true source.
- Response to provocation at the site of pain is fairly faithful in incidence and intensity but not in location.
- Secondary central excitatory effects frequently accompany the deep pain.

Clinical Characteristics Displayed by Neurovascular Pain Disorders

- The pain is severe, throbbing, often debilitating
- The patient often reports photophobia, phonophobia and osmaphobia
- Nausea associated with pain is typical and vomiting is frequent
- Between attacks, the patient is without pain.

Clinical Characteristics Displayed by Episodic Neuropathic Pain

- The pain is quick, sharp and often described as shock-like (Paroxysmal)
- The pain is intense, debilitating pain.
- The duration of the pain is momentary (Seconds)
- There is little to no pain between episodes.
- The pain follows the peripheral distribution of a nerve.

Clinical Characteristics Displayed by Psychological Factors

- The site of pain lacks an adequate, anatomically related source of nociceptive input.
- Its clinical behavior and responsiveness to reasonable therapy is unusual, unexpected and nonphysiologic.

Common Conditions Associated with Pain

1. Headache (cephalgia)
 - Extremely common form of somatic pain
 - Vascular spasm is the causative mechanism along with emotional and muscular stress
 - Increase intracranial pressure including edema following injury and enlarging neoplasms can also produce headache
2. Classic migraine headache:
 - Caused by vascular spasm, initiated by the release of endogenous vasoactive mediators such as serotonin and bradykinin
 - More in females between ten to thirty years of age
 - May be familial.
 - Stress menstruation could be precipitating factors
 - Pain results from vasoconstriction in or near the head followed by distant vasodilatation.
 - Patient often has a premonition of the attack followed by a visual aura described as flashing lights or blurred vision that is caused by ophthalmic artery spasm. This is immediately followed by numbness, tingling, nausea, vomiting, photophobia and intolerance to loud noises.
 - Severe unilateral pain that develops in the region of the eye, forehead, temples, jaw or neck. The symptoms last from several hours to a day or two
3. Trigeminal neuralgia (Figure 10.1)
 - It is usually seen in persons above 35 years of age
 - Right side of the face is affected more than the left by a ratio of about 1.7:1
 - Pain itself is of a searing stabbing or lancinating type

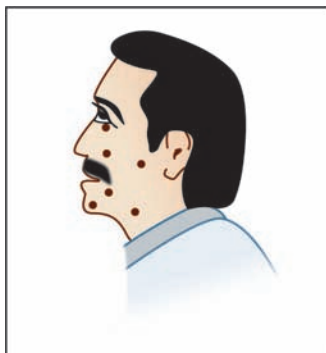


Figure 10.1: Trigger zones

- Trigger zones (pain is initiated by touching these zones) are present on the face. The common areas are vermilion border of the lips, alae of the nose, cheeks and around the eyes. Trigger zones are usually along the branch of the trigeminal nerve, which gets diseased.
 - Pain lasts from a few seconds to several minutes and characteristically disappears as promptly as it arises.
 - Patient usually avoid touching over the trigger area and go unwashed or unshaven to forestall any possible triggering of an attack
 - Precipitating factor may be strong breeze, smiling, eating, etc.
4. Burning Mouth Syndrome
- Burning mouth syndrome (BMS) is also referred to as Scalded mouth syndrome, Burning lips/tongue syndrome, Glossodynia and Stomatopyrosis. BMS can be defined as a burning sensation in the tongue or oral mucous membranes, in the absence of clinical or laboratory findings. Lamb et al. developed a classification system to group BMS based on the varied course of symptoms.
- Type 1 is defined as the absence of symptoms upon awakening, with gradual increase in severity as the day progresses.

Type 2 patients describe the burning as being present day and night.

Type 3 patients are characterized as those with days of remission, which follows no specific pattern.

Clinical features

1. Women are generally more commonly affected than men. It generally occurs in middle-aged or older individuals
2. Tingling or numb sensation in the mouth or on the tip of the tongue associated with a bitter or metallic taste
3. The tip of the tongue is the most common location (71%), followed by the lips (50%), lateral borders of the tongue (46%), dorsum of the tongue (46%), and palate (46%)
4. Some patients do not have burning mouth on awakening but find that the pain intensifies during the day and into the evening. Some awake with a constant daily pain, while others feel pain on and off throughout the day.

Associated and Precipitating Factors

1. Psychological factors: Emotional disorders, particularly depression but also anxiety and cancerophobia are often associated with burning mouth syndrome.
2. Nutritional deficiencies: Iron, Zinc, and vitamin B deficiencies may be associated with burning sensation in the oral cavity.
3. Neuropathies, gastroesophageal reflux and endocrinal diseases such as diabetes and hypothyroidism may be associated with a burning mouth.
4. The mouth burning may be due to allergies or reactions to foods, food flavorings, other food additives, fragrances, dyes or other substances.
5. Certain medications. Angiotensin-converting enzyme (ACE) inhibitors, used to treat high blood pressure, may cause side effects that include a burning mouth.
6. Hormonal imbalances, such as those associated with menopause causes burning mouth.
7. Burning mouth may occasionally be seen in individuals with ill-fitting dentures.

5. Myofascial Pain Dysfunction Syndrome

A symptom complex consisting of pain, muscle tenderness, clicking in the joint, and limitation or alteration of mandibular movement. The symptoms are subjective and manifested primarily in the masticatory muscles rather than the temporomandibular joint itself. Etiologic factors are uncertain but include occlusal disharmony and psycho physiologic factors.

Costen in 1934 was the first to state that TMJ symptoms and occlusion were intimately related. He described a condition that was referred to as TMJ syndrome. S Schwartz in 1955 said that most of the patients who suffered from TMJ syndrome was because of spasm of the masticatory musculature. He called this TMJ – Pain Dysfunction Syndrome. He also noted that many TMJ sufferers had an altered psychological make-up as well. Schwartz's research represents a transition from a strict occlusal etiology to the concept that the occlusion plus the patient's psychological make-up are seen as causative. Laskin, in 1969, offered the four following clinical signs of the "TMJ - Pain Dysfunction Syndrome:" The classic signs that Laskin discovered were pain, muscle tenderness, clicking and limitation of movement.

Laskin suggested the term "Myofascial Pain Dysfunction Syndrome" (MPDS) as being more descriptive since pathologic involvement of the joint structures occurs in the very late stages.

Although other symptoms cannot be definitely excluded from this syndrome, the findings of pain and tenderness of the masticatory muscles is significant, and the lateral pterygoid muscle is the most frequently involved. Pain is also frequently associated with the condylar head. The lateral pole of the condyle will generally be tender on palpation. Joint sounds, consisting of clicking, popping or crepitation are also very common. Clicking, however, is not always associated with pain, nor does it necessarily indicate the onset of pain. Limitation of mandibular motion is seen in well over 50 per cent of patients with this syndrome. However, hypermobility or subluxation of the condylar heads may occur instead, and this may or may

not be associated with pain. Limitation of movement may be caused by muscle spasm, or an anteriorly displaced disc, while hypermobility is frequently associated with atrophic changes.

6. Giant Cell Arteritis

It is a vascular condition that is also referred to as temporal arteritis. The term giant cell arteritis is more preferred since the condition can involve any artery in the head and neck region and may not involve only the temporal vessels.

Clinical findings

1. Usually involves elderly individuals
2. Patients may complain of cramp-like pain associated with the masseter, usually aggravates on masticatory function
3. One or more extracranial vessels are tender on palpation
4. Occasionally giant cell arteritis can be regarded as an emergency condition when patient loses sight.
5. The erythrocyte sedimentation rate in these individuals is significantly elevated.

It can be managed with steroid therapy.

7. Atypical Odontalgia

Atypical odontalgia, also known as idiopathic or phantom tooth pain, was first reported by McElin and Horton in 1947. It is usually characterized by persistent toothache following pulp extirpations, apicoectomy, or tooth extraction. Facial trauma and inferior alveolar nerve block have also been found to cause atypical odontalgia.

Epidemiologic information indicates that 3 to 6% of patients develop atypical odontalgia after endodontic treatment. Characteristically, atypical odontalgia presents as prolonged periods of constant throbbing or burning pain in teeth or the alveolar process. This is in the absence of any identifiable odontogenic etiology observed clinically or radiographically. The pain is chronic; however, the patient's sleep is undisturbed, and there may be a brief symptom-free period on waking.

Patients often have difficulty localizing the pain. It is usually worst at the site of the original trauma, but can spread to adjacent areas, unilaterally or bilaterally. All ages can be affected, except for children; there is a preponderance among women in their mid-40s. Molars and premolars in the maxilla are most often affected. Local anesthetic block gives ambiguous results, and patients rarely find relief with analgesics, including narcotics.

Unfortunately, atypical odontalgia is often mistaken for a normal post-treatment or post-trauma complication. Although it is tempting to consider, psychological co-morbidity has not been demonstrated in atypical odontalgia. As in several chronic pain conditions, a high level of demoralization is evident. However, it is uncertain whether this is the cause or the effect of the condition.

Many classification and diagnostic criteria for atypical odontalgia have been proposed. However, it remains a diagnosis of exclusion after ruling out all other pathologies of the head and neck. Patients often seek multiple endodontic or surgical treatments, realizing no relief or even exacerbation of their symptoms. The pathophysiology of atypical odontalgia remains unclear. In 1978, Marbach hypothesized that atypical odontalgia was of similar etiology to phantom limb pain. Deafferentation research has demonstrated that, after injury, organization and activity of central and peripheral nerves can change. This can result in chronic pain and other related symptoms (paresthesia, dysesthesia). For example, neuroma secondary to nerve trauma is thought to result in such pain. Other mechanisms involved in the pathogenesis of pain include sensitization of pain fibres, sprouting of adjacent afferent fibres, sympathetic activation of afferents, cross-activation of afferents, loss of inhibitory mechanisms and phenotypic switching of afferent neurons. These processes may underlie the clinical manifestation of atypical odontalgia. Treatment of atypical odontalgia is similar to that of other neuropathic conditions. Tricyclic antidepressants (TCAs), alone or in association with phenothiazines, have been prescribed with good results. Although these are mood-altering medications, their effectiveness is attributed to their ability to produce a low-grade analgesia in low doses. Topical application

of capsaicin to painful tissue has also been investigated as a treatment for atypical odontalgia.

8. Glossopharyngeal Neuralgia

Glossopharyngeal neuralgia (GPN) is characterized by a severe lancinating pain in the posterior pharynx, tonsillar fossa, and base of the tongue. It is induced frequently by swallowing and yawning.

Glossopharyngeal neuralgia is believed to be caused by irritation of the ninth cranial nerve. Symptoms usually begin in people over 40 years of age. In most cases, the source of irritation is never discovered. Nevertheless, tumors or infections of the throat and mouth, compression of the glossopharyngeal nerve by neighboring blood vessels, and other lesions at the base of the skull can sometimes cause this type of neuralgia.

Symptoms include severe pain in the areas connected to the ninth cranial nerves. This includes the throat, tonsillar region, posterior third of the tongue, nasopharynx, larynx, and ear. The pain is episodic and may be severe. It can sometimes be triggered by swallowing, chewing, speaking, laughing, or coughing.

Radiographic investigations can be carried out to identify tumors at the base of skull. Sometimes the MRI may show evidence of inflammation of the glossopharyngeal nerve. To determine whether a blood vessel is compressing the nerve, some pictures of the brain arteries can be obtained using techniques, such as magnetic resonance angiography (MRA) or conventional angiography.

Anti-seizure medications, like carbamazepine, gabapentin, and phenytoin are the drugs of choice to manage glossopharyngeal neuralgia. Anti-depressants like amitriptyline have also been tried with variable degrees of success. In severe cases, when pain is difficult to treat, surgery aiming at decompressing the glossopharyngeal nerve may be required, which is generally considered effective.



Examination of Salivary Glands

There are three major paired salivary glands along with other minor salivary glands in the oral cavity. The major salivary glands are the Parotid, Submandibular and Sublingual glands. Based on the location the minor salivary glands are named labial, buccal and palatal.

ANATOMIC LOCATION OF THE MAJOR SALIVARY GLANDS

Parotid Gland

Parotid gland is located in the pre auricular area, slightly over the masseter muscle extending behind the posterior border of the mandibular ramus. The gland is drained by *Stenson's duct* and its orifice opens in the buccal mucosa adjacent the maxillary first molar.

Sublingual Gland

The sublingual salivary gland is located immediately under the mucous membrane of the floor of the mouth. (Sublingual fold or plica sublingualis) resting on the mylohyoid muscle. The duct pattern of the sublingual gland is variable. Most of the ducts of this gland open along the crest of the plica sublingualis (ducts of Rivinus), while one major duct (Bartholin's) can join the Wharton's duct and open commonly with or along it.

Submandibular Gland

The submandibular gland is located in the posterior part of the submandibular triangle. The greater part of the gland is superficial, while a small deep portion curves around the posterior free margin of the mylohyoid muscle. The secretion of the gland is drained by *Wharton's duct*. It opens sublingually on either side of the lingual frenum at the summit of the sublingual caruncle.

EXAMINATION OF MAJOR SALIVARY GLANDS

Parotid Gland

The region of the parotid gland is inspected for discrete swellings and gross enlargements. Elevation of the ear lobe bilaterally should be evaluated. Intraorally the parotid papilla and the orifice of the stenson's duct should be inspected for enlargements, inflammatory changes or pus discharge.

The region of the parotid gland should be palpated bilaterally to evaluate for tenderness and consistency of any enlargements associated with the gland. The stensons duct should be palpated bimanually along its course (Figure 11.1). The ductal orifice should be dried and the nature, character and amount of secretion of the gland should be evaluated. Milking the gland can assess the salivation and nature of discharge from the ductal orifice. Milking the gland also helps to detect ductal obstruction and inflammatory changes (tenderness). Normally saliva expressed from the parotid gland is colorless, odorless and clear.



Figure 11.1

Submandibular Gland

Inspect for any obvious enlargements in the submandibular region. The submandibular gland should

be palpated bilaterally by exercising superolateral pressure with the fingers while the patient relaxes the tongue.

It is important to rule out submandibular lymphadenopathy. Bimanual palpation of the gland is performed by pressing the index finger into the floor of the mouth while the fingers of the other hand are placed extra orally to palpate the submandibular salivary gland. The openings of the Wharton's duct are wiped dry using sterile gauze and the quality and quantity of the saliva is assessed. A forward and upward pressure is applied at the posterior portion of the submandibular triangle over the region of the submandibular gland by drawing the fingers anteriorly. This maneuver helps in expressing saliva through the ductal orifice (Figure 11.2).

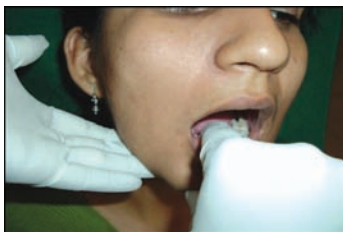


Figure 11.2

Sublingual Gland

The sublingual salivary gland can be inspected and palpated at the middle third of the tongue, close to the attachments of the extrinsic tongue muscles.

EXAMINATION OF MINOR SALIVARY GLANDS

Minor salivary glands are named based on their location such as labial, palatine and buccal. The inferior apical lingual minor salivary gland is also called Blandin-Nuhn glands. The tonsillar minor salivary glands are referred to as Weber's glands and the retromolar salivary glands are called Carmalt's minor salivary glands.

Examination

The site to be examined should be dried using dry sterile gauze. The dried surface is examined for formation of small droplets of



Figure 11.3

saliva. Usually after drying the surface the droplets of saliva are formed in one minute. The lower lip can be examined by everting the lip (Figure 11.3).

DISORDERS OF THE SALIVARY GLAND

Common Symptoms of Salivary Gland Dysfunction

The usual symptoms indicative of salivary gland dysfunction are

- Swelling over the middle third of the face on one side or both the sides. Swelling in relation to the submandibular and sublingual salivary gland.

- Dry mouth (xerostomia)

- Difficulty in chewing, swallowing and speaking

- Pain in the location of the salivary gland, which generally aggravates on consuming food

- Intolerance to spicy food (burning sensation of the oral mucosa).

Dry Mouth (xerostomia)

Dry mouth is also called xerostomia. Xerostomia is considered a sign rather than a disease process by itself. Patients who have reduced salivation suffer from oral lubrication thereby affecting many functions and develop oral and salivary gland infections as a consequence of the reduced defenses.

Causes for Dry Mouth

1. Dehydration
2. Diseases affecting the salivary glands
 - Sjögrens syndrome
 - HIV salivary gland diseases
 - Sarcoidosis
 - Cystic fibrosis
 - Salivary gland aplasia
 - Salivary duct obstruction
3. Iatrogenic causes
 - a. Drugs
 - i. Sympathomimetic drugs (certain antihypertensive drugs)
 - ii. Anticholinergic drugs (tricyclics, phenothiazines, antihistamines)
 - iii. Cytotoxic drugs
 - b. Irradiation
 - i. External beam radiation to treat neoplasms in the head and neck region
 - ii. Iodine 131 to treat thyroid disease
4. Psychogenic causes

Clinical Features of Dry Mouth

1. Difficulty in eating dry foods such as biscuits (cracker sign)
2. Unpleasant taste or loss of sense of taste
3. Lips are dry and atrophic
4. Buccal mucosa is pale and corrugated
5. There's a marked increase in the incidence of caries and erosion of teeth
6. Lipstick and Tongue blade signs are positive
7. Thin lines of frothy saliva may form along the lines of contact of oral soft tissues

Lipstick sign: presence of lip stick or shed epithelial cells on the labial surfaces of maxillary anterior teeth.

Tongue blade sign: When a tongue blade or mouth mirror is moved over the buccal mucosa, it adheres to the mucosa.

Clinical Examination

Prior to clinical examination the following details are recorded.

History of radio-therapy for head and neck malignancies
History of medication
History of dryness in other sites like the eyes, nose, skin and vagina.



Figure 11.4: Mouth mirror test

Examination: The mirror surface of the mouth mirror should be placed over the buccal mucosa and moved along the mucosa. If the mirror glides easily then the mucosa is said to be moist and salivation can be thought to be adequate. However if the mirror clings onto the mucosa then the salivation is said to be reduced and xerostomia may be present (Figure 11.4).

Mucocele

It is a mucus extravasation phenomenon. It results from the rupture of a salivary gland duct and spillage of mucin into the surrounding soft tissues. Mucocele is not a true cyst as it lacks epithelial lining.

Clinical Features

1. 75 % of mucoceles occur in the lower lip. Palate and retromolar areas are rarely involved.
2. Mucoceles are dome shaped mucosal swellings measuring from 1-2 mm to several centimeters in size.
3. They are mostly fluctuant and exhibit a bluish translucent hue as a result of the spilled mucin.

Management

Most mucoceles rupture and heal over a period of time. However some lesions have to be removed. The surgical removal includes

the removal of the adjacent minor salivary glands that feed the lesion.

Ranula

Mucoceleles that occur in the floor of the mouth are referred to as Ranula. In Latin "rana" means frog. The term ranula is used, as the swelling resembles the belly of a frog. Ranula may be formed as mucus extravasation phenomenon or mucus retention. Ranulas are generally associated with the sublingual salivary gland.

Causes for Ranula Formation

Trauma, obstructed salivary gland or ductal aneurysm.

Clinical Features

1. Ranula is seen in the floor of the mouth as a painless, soft, slow growing, movable mass.
2. Generally mucoceleles occur on one side of the lingual frenum. However large lesions may cross the midline.
3. Superficial ranulas have a bluish translucent hue.

"Plunging or cervical ranula" is a term used to refer to deep seated lesion that herniates through the mylohyoid muscle and extends along the fascial planes.

Management

Intralesional injection of corticosteroids can be used for treating small lesions and to reduce the size of larger ranulas.

Marsupialization along with unroofing of the lesion is generally helpful. However recurrences are a common finding with this technique. Surgical excision of lesion and the associated salivary gland is carried out for larger lesions.

Sialolithiasis

Salivary stones, salivary calculi or Sialoliths are calcified structures that are present within the salivary ductal system. Sialoliths are

formed by the deposition of calcium salts over nidi of bacteria, ductal epithelial cells, inspissated mucus or foreign bodies.

Submandibular salivary gland has a higher incidence of sialoliths as the Wharton's duct has a long, tortuous upward path and the mucoid secretions of the submandibular salivary gland are thicker compared to the secretions of the parotid gland.

Clinical Features

Sialoliths are commonly seen in young and middle aged adults

Patient complains of episodic pain and swelling of the affected gland especially with the intake of food.

Sialoliths that are presented at the terminal portion of the duct can be palpated as a hard mass.

Investigations: Mandibular occlusal radiographs can be taken to detect submandibular/sublingual gland and duct calculi. Alternatively sialography can be employed to detect and duct sialoliths within the parotid/submandibular salivary glands.

Management

Sialoliths of smaller dimension can be milked through the duct to the ductal orifice by gentle massage of the obstructed duct.

Patient can be instructed to increase the fluid intake and apply moist heat over the affected gland

Sialogogues that stimulate salivary secretion can be prescribed.

Larger sialoliths can be removed surgically.

Sialadenitis

Sialadenitis refers to the inflammation of the salivary glands. Sialadenitis can be caused by various infectious and non infectious causes (Figure 11.5).

Bacterial infections are caused because of ductal obstruction or reduced salivary flow allowing retrograde spread of bacteria through the ductal system.



Figure 11.5: Bilateral enlargement of parotid gland

Amongst the viral infections affecting the salivary gland, mumps is the commonest.

Mumps

It is also called epidemic parotitis. Mumps is caused by paramyxovirus.

Clinical Features

1. 30% of the cases are subclinical (asymptomatic)
2. Prodromal symptoms including low grade fever, headache, malaise, anorexia and myalgia
3. Parotid gland is most commonly affected
4. Discomfort and swelling involving the tissues surrounding the lower half of the external ear and the postero-inferior border of the mandible.
5. Pain increases with chewing movements and eating. Saliva stimulating foods aggravates pain.
6. Unilateral involvement is seen in 25% of the patients

Other findings include, epididymoorchitis, oophoritis and mastitis.

Sjögren's Syndrome

Sjögren's syndrome is a systemic autoimmune disorder that primarily involves the salivary and lacrimal glands resulting in xerostomia (dry mouth) and xerophthalmia (dry eyes).

Clinical Forms

1. Primary Sjögren's syndrome: (sicca syndrome)–xerostomia and xerophthalmia
2. Secondary Sjögren's syndrome – sicca syndrome + presence of an autoimmune disorder

San Diego Criteria for Sjögren's Syndrome

- I. Primary Sjögren's syndrome
 - A. Symptoms and objective signs of ocular dryness
 1. Schirmer's test less than 8 mm wetting per 5 minutes, and
 2. Positive Rose Bengal staining of cornea or conjunctiva to demonstrate keratoconjunctivitis sicca.
 - B. Symptoms and objective signs of dry mouth
 1. Decreased parotid flow rate using Lashley cups or other methods, and
 2. Abnormal findings from biopsy of minor salivary gland (focus score of greater and or equal to 2 based on average of four evaluable lobules).
 - C. Serologic evidence of a systemic autoimmunity
 1. Elevated rheumatoid factor > 1:320, or
 2. Elevated antinuclear antibody (ANA) > 1:320 or
 3. Presence of anti-SS-A (Ro) or anti-SS-B (La) antibodies

II. Secondary Sjögren syndrome

Characteristic signs and symptoms of Sjögren syndrome (as previously described), and clinical features sufficient to allow a diagnosis of rheumatoid arthritis, systemic lupus erythematosus, polymyositis, scleroderma, or biliary cirrhosis.

Exclusions: sarcoidosis, preexisting lymphoma, human immunodeficiency virus (HIV), Hepatitis B or C, primary fibromyalgia,

and other known causes of autonomic neuropathy, keratitis sicca, or salivary gland enlargement.

Tumors Affecting the Salivary Glands (adapted from the WHO classification)

Epithelial Tumors

Adenomas (benign)

- Plieomorphic adenoma
- Monomorphic adenoma
- Mucoepidermoid (intermediate)
- Acinic cell tumors (intermediate)

Carcinomas (malignant)

- Adenoid cystic carcinoma
- Epidermoid carcinoma
- Undifferentiated carcinoma
- Carcinoma in plieomorphic adenoma

Rule of Nines

It is said that 9 out of 10 salivary gland neoplasms affect the parotid, 9 out of 10 are benign and 9 out of 10 are plieomorphic salivary adenomas.

Plieomorphic Adenoma

It is the most common salivary gland neoplasm also referred to as a benign mixed tumor affecting the salivary glands.

Commonly involves the Parotid gland (55-70%).

Clinical Features

1. Slow growing, painless, firm mass
2. Commonly affects young adults between the ages of 30 and 50.
3. Superficial lobe of the parotid is affected.
Around 5% of all cases of plieomorphic adenomas undergo malignant transformation.
4. Facial nerve palsy is a rare feature
5. Larger tumors generally become immobile

Minor salivary gland mixed tumors are generally seen affecting the palate (60%)

The palatal lesion is seen as a smooth surfaced, dome shaped mass.

Mucoepidermoid Carcinoma

Malignant carcinoma is one of the most common malignancies affecting the salivary glands. It is also the most common salivary gland malignancy affecting children.

Clinical Features

1. Generally seen between the 2nd and 7th decades of life
2. Usually affects the parotid gland
3. Asymptomatic swelling occasionally associated pain or nerve palsy
4. Tumors affecting the minor salivary glands mimic mucocoeles. They are commonly seen on the palate as fluctuant bluish red colored swellings.
5. Generally causes facial nerve paralysis
6. Metastasizes to the regional lymph nodes and distant sites like the bone, brain and lung

Adenoid cystic carcinoma

Adenoid cystic carcinoma is also referred to as cylindroma.

Clinical Features

1. 40 to 50% of the tumors are seen in the palatal minor salivary glands
2. Usually affects individuals in the age group of 30 to 40 years
3. Slowly progressive swelling associated with pain
4. Facial nerve paralysis is a common finding
5. Radiographs will reveal bone destruction when the maxillary sinus or the palate is involved.
6. These tumors metastasize to the lungs and bones.



Examination of Maxillary Sinus

The diseases that affect the maxillary sinus are many in kind and number and varied in complexity. The dentist must recognize and evaluate the image of the inferior portion of the maxillary sinus that is invariably seen on the radiographs of maxillary posterior teeth. Since many of the pathoses that involve the maxillary sinus may refer pain to the dental structures, the oral physician must have a thorough knowledge of the diseases affecting the maxillary sinus and their effects on oral tissues.

The four paranasal sinuses are a group of air cavities that surround the nasal chambers and take their names from the bones in which they are located—the maxillary, the frontal, the ethmoid and the sphenoid sinuses (Figure 12.1).

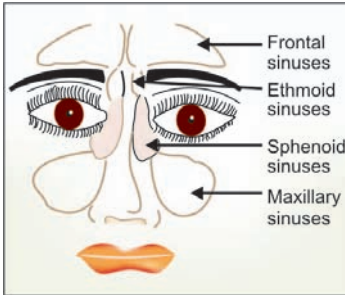
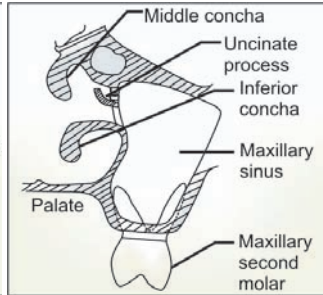
The Maxillary Sinus is the largest of the group and is closely related to the dento-oral complex. It originates as the out pouching of the nasal mucosa during fetal life or early childhood.

Nathaniel Highmore, is thought to have been the first to recognize the anatomic and clinical significance of the Maxillary Sinus. Hence, it is also referred to as “Antrum of Highmore”.

ANATOMIC CONSIDERATIONS (FIGURE 12.2)

The Maxillary Sinus is the largest of the paranasal sinuses and is a cavity in the body of maxilla, which is pyramidal in shape, consisting of a base, an apex and four sides that respectively face upwards, downwards, backwards and forwards.

Its base comprises of the thin lateral wall of nasal cavity and forms the hiatus semilunaris in the disarticulated bone. The

**Figure 12.1:** Paranasal sinuses**Figure 12.2:** Coronal section of the maxillary sinus

Maxillary Sinus communicates with the posterior part of the hiatus in the middle meatus via an aperture, the maxillary ostium that measures about 3-6 mm in diameter. Sometimes an accessory ostium is present posterior to the principle one and it may even be larger than the normal opening. In rare cases 2 or even 3 accessory openings may be present.

The apex of the Maxillary Sinus is formed by the zygomatic process of the maxilla and in some instances when the sinus is large; it extends into the zygomatic bone itself. The four walls of the pyramid are formed by the floor of the orbit (i.e. the roof of the antrum), the anterior and infratemporal surfaces of the body of the maxilla and alveolar process of the maxilla, which is the floor of the sinus.

The infraorbital nerve and vessels enter through a canal within the bony roof of the antrum and exit into the face through the infraorbital foramen. (This is sensory and originates from the maxillary branch of trigeminal nerve). The posterior superior alveolar nerve branches from the infraorbital nerve just before it enters the canal on the posterolateral wall of the sinus. Along with the anterior and middle superior alveolar branches that also reach the floor through canals in the lateral sinus walls, it provides innervations to the maxillary bone, teeth, periodontal ligament, mucosa as well as the mucous membrane

of the sinus. In the adult the floor of the sinus is approx. 1.0 to 1.25 cm below the level of the floor of the nasal cavity.

Arterial Supply: Facial, infraorbital and greater palatine arteries

Nerve Supply: Infraorbital and three (anterior, middle and posterior) superior alveolar nerves.

Venous drainage: Into the facial and pterygoid plexus.

Lymphatic drainage: Into the submandibular nodes.

PHYSIOLOGY

The function of Maxillary sinus are not well understood. The presumed functions however are:

- To lighten the skull.
- As resonator for the voice.
- To warm and moisten the inspired air.
- Protection and insulation of cerebrum and orbits.
- Participation in formation of the cranium and evolutionary unwanted space.

EXAMINATION OF THE SINUS

Fascenelli (1969) reported that 26% of the asymptomatic population will have radiographic evidence of maxillary sinus abnormalities. The diagnosis of maxillary sinus disease is usually reserved for those conditions that cause significant subjective symptoms.

Symptoms produced by diseases of Maxillary sinus relates to the face, eye, nasal and oral cavities and superior aspect of head. Pain is the most frequent symptom and may be manifested as deep-seated pain of the maxillary bone on the involved side or else it may be referred to face, eye, nose or premolar or molar teeth. In some instances, patient may complain of vague headache or poorly localized facial pain.

Facial manifestation involves the skin of infraorbital region, the upper lip and the lateral aspect of nose. Complaints such as paraesthesia, anesthesia and the feeling of fullness or pain is common in maxillary sinus disease.

Ophthalmologic complaints include, epiphora, diplopia, a feeling of fullness, and unilateral decrease in vision, pain, or change in position of the eyeball as well as paresthesia or anesthesia of the inferior eyelid.

Nasal symptoms include obstruction, epistaxis, postnasal drip and cacosmia (sensation or hallucination of a stench). The patient relates to history of recent cold or allergic rhinitis or deviated septum. The description of food and liquid discharge through nose during meals suggests an oro-antral communication.

Intraorally majority of complaints focus on the maxillary premolar-molar region. Although paraesthesia or anesthesia is usually unilateral, the complete facial gingiva and mucosa may be involved. Pain is usually related to maxillary premolar and molar teeth or region, the complaint of recent bite problem or an expansion of alveolar process, the adjacent vestibule or the posterolateral hard palate.

Clinical Examination

Extraoral Examination

1. The usual examination should initially be directed toward evaluating the skin in the infraorbital region, checking for unusual redness, changes in sensation, malposition of the eyeball, asymmetry of the face resulting from a swelling over the sinus or a unilateral swelling in posterior maxilla.
2. Palpation of soft tissues over the maxillary sinus may prove helpful, simultaneous finger pressure over both the maxillae applied below the eyes at about the level of the ala of nose, may demonstrate a fullness or difference in tenderness (Figure 12.3).

Although the sinus cannot be examined directly, considerable information about its condition can be gained by noting secretion that drain from it. The intranasal examination of the region where the sinus drains should be carried out using a good light, a suitable (nasal) speculum and vasoconstrictors (3% ephedrine in saline sprayed from atomizer or 2% cocaine will provide added advantage of topical



Figure 12.3

anesthesia). The nature of the discharge whether clear mucus, mucopus, frank pus or blood is significant and should be noted.

All swellings over the maxillary sinus should be palpated to determine whether they are soft tissue or bone. If the expansion proves to be bone then moderate digital pressure should be applied in an effort to detect crepitus. Crepitus would indicate the presence of a disease process that has produced significant thinning of the bone walls. Thinning may or may not be accompanied by expansion of Maxillary sinus.

Intraoral Examination

1. Palpation under the upper lip above the canine and premolar region may reveal fullness or tenderness.
2. *Examination of teeth:* All the maxillary teeth should be percussed to determine if there is unilateral difference in sensitivity of the posterior group. The maxillary teeth on affected side will be tender on percussion. These teeth should be subjected to a vitality test.

Transillumination of the Maxillary Sinus (Figure 12.4)

Transillumination of Maxillary sinus is usually not diagnostic but may yield useful ancillary information. The procedure is conducted in a dark room; a bright fiber optic light is placed in the patient's

mouth and directed towards the palate. Uniform crescents of light will be observed in infraorbital sinus and the pupils will both glow if both sinuses are healthy. A sinus of normal size and aeration will readily permit passage of light but if pathosis is present in the form of a soft tissue mass, calcified material, or fluid such as pus or blood then the transmitted light will be duller or opaque on the affected side.

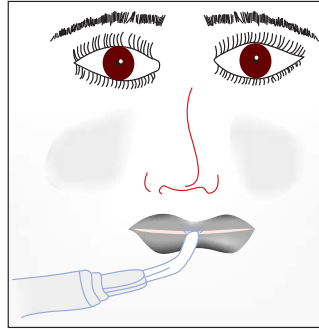


Figure 12.4

As Serous cyst consists of thin fluid and cholesterol crystals, they will permit passage of light and will not be detected by transillumination.

COMMON DISEASES AFFECTING THE MAXILLARY SINUS

The pathologic conditions of the maxillary sinus may be conveniently characterized as:

1. Inflammatory
 - a. Acute sinusitis
 - b. Chronic sinusitis
 - c. Osteomyelitis
2. Cysts
 - a. Intrinsic
 - b. Extrinsic
3. Tumors
 - a. Odontogenic
 - b. Nonodontogenic
4. Trauma
 - a. Fractures
 - b. Foreign bodies
5. Other local osseous pathoses.
6. Systemic diseases

MAXILLARY SINUSITIS

The term Sinusitis is reserved for those conditions causing subjective symptom as well as apparently thickened and hyperplastic lining. The key signs and symptoms are those of sepsis like fever, chill, malaise and elevated white blood count.

Classification

- Acute sinusitis (Few days to 3 weeks)
- Subacute sinusitis (3 weeks to 3 months)
- Chronic sinusitis (Months to years in duration).

Acute Maxillary Sinusitis

Clinical Findings

- a. Heaviness in the face
- b. Throbbing pain over the region of maxillary sinus that aggravates on bending the head
- c. The pain is usually severe in the morning and evening
- d. Foul smelling discharge from the nose
- e. Nasal obstruction on the affected side
- f. Patient may have a productive cough in the night due to collection of pus in the pharynx
- g. Examination will reveal tenderness over the region of the maxillary sinus
- h. Patient may occasionally have anaesthesia over the cheek
- i. Maxillary posterior teeth may be tender on percussion

Chronic Maxillary Sinusitis

Sinusitis lasting longer than 12 weeks is referred to as chronic sinusitis

Clinical Findings

- a. Heaviness over the forehead and maxillary sinus region
- b. Reduced sense of smell and foul breath
- c. Nasal congestion and obstruction

- d. Yellowish discharge
- e. Chronic cough
- f. Postnasal drip (which may cause sore throat)
- g. Facial tenderness or pressure

Oroantral Fistula

It is an un-natural conduit/communication between the oral cavity and the maxillary antrum.

Causes for Oroantral Fistula Formation

1. Accidental exposure of the floor of the sinus secondary to traumatic removal of the maxillary posterior teeth. Occasionally a fragment of the bone may be removed along with the teeth.
2. Penetrating injuries such as gun shot wounds may create a fistula.
3. Malignant tumors: Maxillary sinus neoplasms may erode the bony walls of the sinus. On occasions when the floor of the sinus is eroded the neoplasm invades the oral cavity forming an oroantral communication.
4. Syphilitic gumma: palatal involvement in syphilis causes destruction of the palatal bone thereby giving rise to a fistula.
5. In rare instances patients with maxillary implant denture prosthesis may develop an oroantral fistula.

Signs and Symptoms

1. Regurgitation of the fluids from the mouth into the nose
2. Unilateral epistaxis
3. Change in vocal resonance
4. Inability to blow and hold air in the cheeks
5. Individuals with a smoking habit find it difficult to draw on a cigarette
6. Unilateral foul smelling discharge

Identifying an Oroantral Communication

1. Large oroantral communications are readily evident on inspection.
2. The patient can be instructed to pinch his nostrils and gently blow down the nose (keeping his/her mouth open). A whistling sound may be appreciated as the air passes down the fistula.
3. Alternatively a thin strand of cotton can be placed under the suspected fistula and inspected for any deviation caused by the air passing down the oroantral communication.

The suspected fistulous tract should never be probed as unnecessary probing may dislodge any wound seal and establish a frank communication.

Management

An oroantral fistula present for over 2 weeks should be considered as a chronic oroantral communication and best managed with surgical closure.

Antrolith

They are also called rhinoliths, antral stones or antral calculi. Antroliths are hard calcified substances that are present in the maxillary sinus. These have an irregular and rough surface.

Aetiology

Rhinoliths are formed as a result of mineral salt deposition such as calcium carbonate, calcium phosphate and magnesium over a foreign body, which acts as the nidus. The foreign body could either be endogenous such as blood clot, piece of root or bone fragment or exogenous such as a piece of paper or cotton wool.

Clinical Findings

Antroliths are uncommon and are usually asymptomatic. They are usually diagnosed as an incidental finding on routine radiography.

Antroliths may be rarely associated with acute or chronic sinusitis, blood tinged nasal discharge and rarely facial pain.

Radiographic Findings

Antroliths are seen radiographically as well defined radiopaque foci generally having a smooth outline.

Intraoral periapical radiographs can show rhinoliths situated close to the floor of the antrum. Waters view and orthopantomographs can show the radiopaque rhinoliths situated in the antral cavity.

Management

Antroliths can be removed surgically using the Caldwell- luc approach.

Benign Mucosal Cyst/Antral Polyp

The benign mucosal cyst of the maxillary sinus can have various clinical presentations. In most individuals it is found incidentally on routine radiographic examination. It may present with non-specific signs and symptoms or a well defined fluctuant mass in the nasal/oral cavity may be seen.

Clinical Findings

1. It may occur in any age group
2. It is generally asymptomatic
3. Patient may have a frontal headache or a feeling of heaviness in the frontal and orbital region
4. Occasionally fullness or numbness of the cheek may be present
5. Nasal obstruction and post nasal discharge
6. Deviated nasal septum.

Antral puncture can be used to confirm the presence of mucosal cysts. A wide bore needle can be used intraorally to access the antrum through its lateral wall. Mucosal cysts will yield straw or amber colored clear fluid that has a tendency to coagulate once aspirated.

Radiographic Findings

A rounded dome-shaped homogeneous radiopaque shadow arising from the floor of the sinus. In some cases there may be more than one dome-shaped radiopacity within the sinus. Very rarely the polyps can be seen arising from the lateral walls of the sinus.

Malignant Diseases Affecting the Maxillary Sinus

It is estimated that 0.3% of all malignancies affect the paranasal sinuses. Almost 85% of these involve the maxillary sinus. They occur twice as often in males as in females and usually diagnosed in the 6th and 7th decade of life. The majority of these tumors are squamous cell carcinoma, although a wide variety of other malignancies including sarcoma, adenoid cystic carcinoma, Burkitt's lymphoma, melanoma and basal cell carcinoma may occur.

The reasons for malignancy to occur in the maxillary sinus are multifactorial. However, it is more commonly associated with snuff dipping habit and exposure to the wood dust, nickel dust, isopropyl oil, chromium, or dichlorodiethyl sulfide. These products are widely used in the furniture, leather and the textile industries.

Clinical Findings

In the initial stages the condition is asymptomatic. Patients may occasionally complain of pain, unilateral nasal obstruction and a purulent or serosanguineous discharge.

The clinical presentation of the malignancy depends on the direction of extension and the region of involvement.

1. Involvement of the orbit
 - a. Patient may present with proptosis, diplopia, strabismus and amaurosis.
 - b. If the infra orbital nerve is damaged, patient can present with anaesthesia of the cheek on the affected side.
2. Involvement of the lateral wall of the nose
 - a. Unilateral nasal obstruction
 - b. Epiphora secondary to blockage of nasolacrimal duct

- c. Bleeding from the nose, purulent or serosanguineous nasal discharge
- d. External facial swelling around the ala of the nose
- e. Hemorrhagic and friable mass within the nostril
- 3. Involvement of the cheek
 - a. Facial swelling involving the cheek (resembles dentoalveolar abscess)
 - b. Paresthesia or anesthesia over course of the infra-orbital nerve.
- 4. Involvement of the infratemporal fossa
 - a. Involvement of the sphenopalatine ganglion results in anesthesia/paresthesia of the palate
 - b. Involvement of the maxillary nerve produces numbness of the upper part of the face and lip
 - c. Involvement of the medial pterygoid muscle causes trismus
- 5. Involvement of the floor of the sinus
 - a. Painful/painless swelling in the buccal sulcus in relation to the maxillary premolars and molars.
 - b. Occasionally when a freshly extracted tooth (maxillary premolar/molar) socket is present, a proliferative mass of tissue may be seen protruding from it.
 - c. Tooth mobility in relation to the fungating mass.

Staging of Maxillary Sinus Carcinoma

Stage 1: It is the earliest stage of invasive cancer. The malignancy is contained within the mucosal lining of the sinus.

Stage 2: The cancer involves floor and lateral walls of the sinus (involves the hard palate and middle meatus of the nasal cavity).

Stage 3: The cancer invades into other walls of the sinus. It involves the buccal mucosa, orbit, and ethmoidal sinus. It spreads to one lymph node (not more than 3 cm in size) on the same side of the neck.

Stage 4: It is an advanced stage of the malignancy. It involves the orbit, the skull, nasopharynx, or sphenoid and frontal sinuses.

It may also spread to one lymph node on the same side of the neck, but the node is less than 3 cm in size. Sometimes, multiple nodes are involved bilaterally and can be of any size. In terminal stages the malignancy spreads to involve the lungs, liver or brain.

Radiographic investigations will help in evaluating the extent of bone involved. Intraoral periapical radiographs can be used to detect minute changes in trabecular pattern of bone. A standard Waters view, PA view and CT scan can be used to evaluate destruction of the walls of the sinus and involvement of adjacent structures.

The five-year survival rate for patients with maxillary sinus cancer is about 40%.

Section Two

Radiology



X-ray Machine and Production of X-rays

DISCOVERY OF X-RAYS

X-actly So!

The Roentgen Rays, the Roentgen Rays,
What is this craze
The town's ablaze
With the new phase
Of X-ray's ways.
I'm full of daze
Shock and amaze;
For nowadays

I hear they'll gaze
Thro' cloak and gown- and even stays,
These naughty, naughty Roentgen Rays.

Electrical Review, April 1896

X-rays were discovered in 1895 by Wilhelm Conrad Roentgen (1845-1923) who was a professor at Wuerzburg University in Germany. Working with a cathode-ray tube in his laboratory, Roentgen observed a fluorescent glow from crystals on a table near his tube. The tube that Roentgen was working with consisted of a glass envelope (bulb) with positive and negative electrodes encapsulated by it. The air in the tube was evacuated, and when a high voltage was applied, the tube produced a fluorescent glow. Roentgen shielded the tube with heavy black paper, and discovered a green colored fluorescent

light generated by a material located a few feet away from the tube. He concluded that a new type of ray was being emitted from the tube. This ray was capable of passing through the heavy paper covering and exciting the phosphorescent materials in the room. He found that the new ray could pass through most substances casting shadows of solid objects.

Roentgen also discovered that the ray could pass through the tissue of humans, but not bones and metal objects. One of Roentgen's first experiments late in 1895 was a film of the hand of his wife, Bertha. It is interesting that the first use of X-rays were for an industrial (not medical) application as Roentgen produced a radiograph of a set of weights in a box to show his colleagues.

Roentgen's discovery was received with extraordinary interest by both scientist and laymen. Scientists everywhere could duplicate his experiment because the cathode tube was very well known during that period. Many scientists dropped other lines of research to pursue the mysterious rays. Newspapers and magazines of the day provided the public with numerous stories, some true, others fanciful, about the properties of the newly discovered rays.

Roentgen, who won the first Nobel prize in physics in 1901, declined to seek patents or proprietary claims on the x-rays. This invisible ray caught public fancy with the ability to pass through solid matter, and, in conjunction with a photographic plate, provided a picture of bones and interior body parts. Scientific fancy was captured by demonstration of a wavelength shorter than light. This generated new possibilities in physics, and for investigating the structure of matter. Much enthusiasm was generated about potential applications of rays as an aid in medicine and surgery. Within a month after the announcement of the discovery, several medical radiographs had been made in Europe and the United States, which were used by surgeons to guide them in their work. In June 1896, only 6 months after Roentgen announced his discovery, x-rays were being used by battlefield physicians to locate bullets in wounded soldiers.

ORIGIN OF DENTAL RADIOGRAPHY

Prior to 1912, x-rays were used little outside the realms of medicine, and dentistry. Professor Wilhelm Koenig of Frankfurt, Germany is reported to have made 14 dental radiographs in February 1896. Dr Otto Walkhoff is credited for taking a radiograph (with the help of his assistant) of his own molars. His radiograph required a 25-minute exposure time. Frank Harrison an English dentist proclaimed that he had used only a 10-minute exposure for his dental radiograph. He also said that his radiographs were superior in the sense that his x-ray images demonstrated pulp chambers of teeth, in contrast to Koenig's and Walkhoff's radiographs, which only showed white outlines of the teeth on a black background.

Dr Edmund C. Kells, a New Orleans dentist and inventor, with the help of Professor Brown Ayres took the first dental radiograph in 1896, less than 4 months after Roentgen's discovery of x-rays. In 1899, Kells published an article in *Dental Cosmos* that described the importance of placing the film and object at right angles to the source of x-rays using a film holder.

Radiation

Transmission of energy through space and matter is referred to as radiation.

Forms of Radiation

1. Particulate radiation
2. Electromagnetic radiation

Particulate radiation: Particulate radiation consists of atomic nuclei or subatomic particles that transmit kinetic energy by means of their small masses moving at very high velocities.

Examples of particulate radiation are alpha rays, beta rays and cathode rays. Beta particles are used in radiation therapy for treatment of skin lesions.

Electromagnetic radiation: Movement of energy through space as a combination of electric and magnetic fields is called electro-

magnetic radiation. Altering the path of an electrically charged particle can produce electromagnetic radiation.

Examples: X-rays, gamma rays, ultraviolet light, infrared radiation, television signals, microwaves and radiowaves.

Production of X-rays

X-rays are produced by converting the kinetic energy of electrons in the tube current at the focal spot within the X-ray tube.

X-rays are produced in the x-ray tube by two mechanisms, namely Bremsstrahlung and characteristic radiation. Bremsstrahlung radiation is the major source of x-ray photons from the x-ray tube. Characteristic radiation contributes only to a small amount of X-ray photons that are produced from the X-ray tube.

Bremsstrahlung Radiation

The sudden stopping of high speed electrons at the target produces Bremsstrahlung radiation. Initially electrons are accelerated to a high velocity by creating a high voltage across the gap between the tungsten filament and the target of the X-ray tube. These high speed electrons are directed towards the tungsten target where they interact with the nucleus of the atoms in the tungsten target in two ways namely direct hit and near miss/wide miss (Figure 13.1).

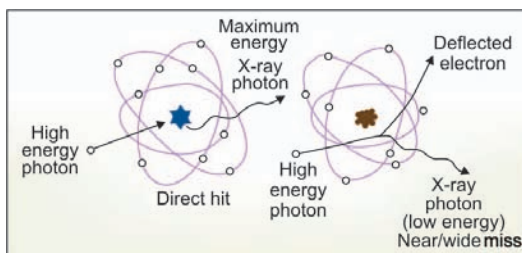


Figure 13.1: Bremsstrahlung radiation

Direct hit: In this interaction the high speed electron collides with the nucleus of the target atom. Only a very few high speed electrons exhibit such head on collisions with the nucleus. In this collision, the total kinetic energy of the high speed electron is converted into a single x-ray photon. The energy of the x-ray photon thus produced is numerically equal to the energy of the high speed electron (which in turn is equivalent to the kilo voltage applied across the x-ray tube at the instant of its passage).

Near miss/wide miss: Most of the high speed electrons directed towards the tungsten target are involved in encounters with the nucleus of the tungsten atom ranging from near misses to wide misses. Because of the attractive force of the nucleus the high speed negatively charged electrons are drawn towards the nucleus thereby resulting in the deflection of the electron from its original path. This results in the electron losing some of its kinetic energy, in which is given out in the form of an X-ray photon. The closer the high speed electron is drawn towards the nucleus greater will be the stopping/braking effect and the energy of the resulting photon.

Characteristic Radiation

In some instances the high speed electron may not interact with the nucleus of the target atom but interacts with the electrons in the outer orbit around the nucleus. The high speed electron displaces the electron of the outer orbits from its shell thereby ionizing the atom. The vacant site in the inner shell produced by the displaced electron is quickly filled up by another electron from an outer shell. When the displaced electron is replaced, a photon is emitted with the energy equivalent to the difference in the two orbital binding energies. (Figure 13.2)

PROPERTIES OF X- RAYS

1. X-rays are forms of electromagnetic radiation.
2. They have short wave length and therefore exhibit a greater penetrating power.

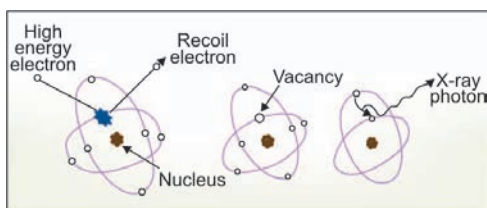


Figure 13.2: Characteristic radiation

3. They travel at the speed of light (3×10^8 meters/second or 1,86,000 miles/second).
4. They affect photographic plates and x-ray films.
5. They travel in straight lines and have a wave form.
6. X-rays are made up of small packets of energy called photons or quanta.
7. They can ionize gases.
8. They cannot be focused using a lens.
9. They can penetrate opaque objects.
10. They follow the inverse square law.
(Inverse square law: For a given beam, the intensity is inversely proportional to the square of the distance from the source).
11. They can stimulate or destroy living tissues.

INTRAORAL X-RAY MACHINE

The intraoral X-ray machine is made up of the following parts (Figures 13.3 and 13.4).

1. X-ray tube head
2. Control panel
3. Swivel arms for maneuverability

X-ray Tube Head (Figure 13.5)

It is made up of an evacuated (vacuumed) Borosilicate glass envelope, which encloses the anode and cathode, power supply circuit, protective lead housing and insulating (coolant) oil between the glass envelope and the outer protective housing.



Figure 13.3: Photograph of an intraoral X-ray unit

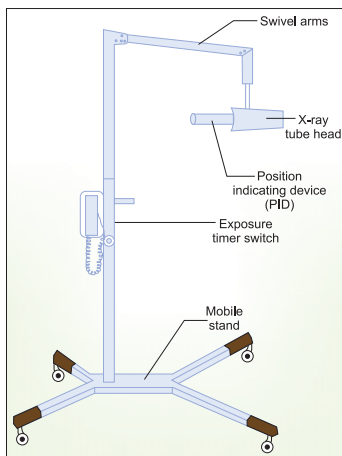


Figure 13.4: Parts of an intraoral X-ray unit

Glass Envelope (Figure 13.6)

It is made of borosilicate glass that is evacuated. The glass tube is evacuated in order

- To prevent collision of the electrons with gas molecules, which might reduce their speed.
- To prevent oxidation “burnout” of the tungsten filament.

Anode

The anode is positively charged. It comprises of a tungsten target that is embedded in a copper stem.

Tungsten target: Tungsten is chosen as an ideal target material because of the following reasons:

- It has a high atomic number (74) – very efficient for production of X-rays.
- High melting point (3360°C)- It is a known fact that almost 99% of the kinetic energy of electrons is converted to



Figure 13.5A: X-ray tube with insulating oil



Figure 13.5B: Cathode and anode

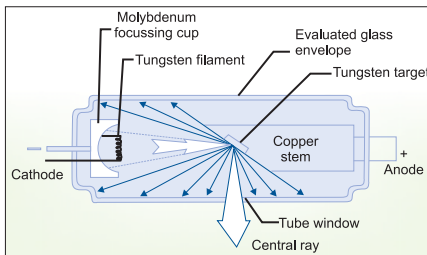


Figure 13.6: Construction of an X-ray tube

heat, therefore making it necessary for the target to withstand high temperatures.

- c. Low vapor pressure- It helps in maintaining the vacuum in the tube at high temperatures during the operation of the machine.

The tungsten target is angulated at about 20° to the central ray of the X-ray beam.

Copper stem: The tungsten target is embedded in a copper stem. In order to compensate for the poor thermal conductivity of tungsten, the target is embedded in a copper stem, which is a good conductor of heat. It carries away the heat from the tungsten target thereby preventing tungsten from melting with at high operating temperatures.

Cathode

The cathode is negatively charged. It comprises of a filament and focusing cup.

Filament: The filament is made up of tungsten. The tungsten filament is in the shape of a coil, which is about 1cm in length, and the coil of wire used is about 2 mm in diameter. The coil is mounted on supporting rods that carry the power supply to the filament. To produce x-rays, the filament is heated to incandescence using current from a low voltage source. The tungsten filament in turn gives out electrons at a rate that is proportional to the temperature of the filament.

Focusing cup: The filament lies in the focusing cup. The focusing cup is made up of molybdenum. It is a negatively charged concave reflector, which electrostatically focuses the electrons into a narrow beam that is directed towards the focal spot.

Power Supply Circuit

The power supply circuit of the x-ray tube head mainly consists of a step down transformer; high voltage transformer and electrical insulating oil surrounding the transformers. The transformers are encased in an electrically grounded metal housing. Other parts of

the power supply circuit are a filament current (mA) control switch and a kilovolts peak (kVp) selector dial.

Step down transformer: Helps to reduce the voltage of the incoming alternating current to about 10 volts. This is controlled by the mA switch. The step down transformer provides a low voltage current to heat the filament of the x-ray tube.

High voltage transformer: Helps in generating a high potential difference between the anode and cathode, thereby accelerating the electrons from the cathode towards the anode in order to generate X-rays.

Electrical insulating oil: This oil acts as a coolant as well as an electrical insulator. The insulating oil aids in dissipation of heat produced by the X-ray tube.

Control Panel

Most of the intraoral machines available have the facility to adjust the tube voltage and tube current. However of the machines operate at fixed parameters. X-ray machines used for taking intraoral radiographs are calibrated at about 60 to 65 kVp and 8 mA.

The exposure time is usually one parameter that the dentist can control. The exposure time in most machines can be adjusted from 0.1 seconds to a 3 second exposure. It is used to control the duration of X-ray exposure. The timer is sometimes referred to as "dead man's switch".

Working Principle

To ensure a sufficient rate of electron emission, the tungsten filament should be pre heated to an optimum operating temperature. The timer circuit initially sends a current through the filament for about half a second in order to heat the filament and bring it an optimum operating temperature. Once the filament is heated to an optimum temperature, the timer applies power to the high voltage circuit.

However it is not practical to keep the filament preheated continuously as it shortens the life span of the tungsten

filament. Accordingly, it is not advisable to leave the X-ray machine switched on all through the working hours.

Dissipation of Heat from the X-ray Machine

It is understood that 99% of the electrons emitted contribute to the heat generated in the x-ray machine and only 1 % contribute to x-ray production.

Various methods are employed to dissipate heat from the x-ray machine.

1. The x-ray machine should be operated in an air conditioned environment with the temperature about 18 to 20°C
2. Presence of an insulating oil or coolant between the x-ray tube and the outer protective housing.
3. Embedding the tungsten target in a copper stem. Copper being a good conductor of heat carries away the heat from the target.
4. Angulating the target to about 20° helps in minimizing the heat generated at the focal spot
5. Using a rotating anode minimizes the heat generated during the production of x-rays. A rotating anode provides a large surface area at the focal spot thereby aiding in the dissipation of heat.

Filters and Collimators

X-rays produced in the x-ray tube exit the glass envelope through the exit port. Before the x-rays reach the object to be imaged they pass through the filter and then the x-ray beam is collimated and directed at the area of interest using the position-indicating device (PID).

Filters

X-ray photons produced in the x-ray tube consists of photons of various energy levels. It is a known fact that photons of the maximum energy contribute to the production of the latent image on an image receptor system film and photons of low energy contribute to exposure of the patient. Studies have



Figure 13.7: Photograph showing aluminium filter

shown that the surface exposure levels reduce to about 20% when the X-ray beam is filtered.

Photons of low energy levels have a low penetrating power and hence do not aid in formation of an image of diagnostic quality. It becomes necessary to prevent photons of low energy and low penetrating power from reaching the patient. This is achieved by using a filter at the exit port of an x-ray tube.

Design: Filter is made up an Aluminium disc. It selectively allows the passage of high-energy x-ray photons and prevents the low energy x-ray photons from leaving the x- ray tube. The Aluminium disc is about 0.1 mm in thickness (Figure 13.7).

Types of Filtration:

1. Inherent
2. Added
3. Total

1. *Inherent Filtration:* As the name suggests it is the filtration offered by the design of the x-ray tube. Various components of the x-ray tube such as the borosilicate glass envelope, insulating oil and the sealant that prevent the leakage of the insulating oil, by way of design prevent low energy x-ray photons to leave the x-ray tube housing.

This inherent filtration is equivalent to 0.5 to 2 mm of Aluminium.

2. *Added Filtration:* Aluminium discs of various thicknesses as per the requirement are placed at the exit portal.

3. *Total Filtration*: It is the sum total of both the inherent filtration and added filtration.

The amount of filtration required is based on the tube voltage of the machine that is used. The quantity of filtration required is expressed as *Half Value Layer*.

Half Value Layer

Half value layer is the thickness of Aluminium required to reduce by half the number of x-ray photons passing through it.

For a machine operating between 30 to 70 kVp, total filtration should be about 1.5 mm and a machine operating at 90 kVp the total filtration required is about 2.5 mm of Aluminium.

Added note: Along with Aluminium filters, rare earth materials like Erbium, Yttrium and Samarium have been used as filters. These filters used in conjunction with aluminum filters further reduce the patient exposure. However, the exposure time has to be increased by almost 50% and the contrast, resolution and sharpness of the resultant image is reduced.

Collimators

Collimator is a metallic barrier with a central aperture, which is used to contain the size of the x-ray beam to the required site of exposure (Figures 13.8 A and B).

The collimator is generally made up a thick plate of lead (radiopaque substance).

Functions of the Collimator

1. Reduces patient exposure by containing the size of the X-ray beam to the site that has to be exposed.
2. Prevents scattered radiation from reaching the film, that add to film fog and thereby degrading the diagnostic quality of the radiographic image.



Figures 13.8A and B: Photograph showing diaphragm collimator

Types of Collimators: (Figure 13.9)

Based on the shape collimators can be classified as:

1. Rectangular collimators
2. Diaphragm collimators
3. Tubular collimators

A rectangular collimator reduces the skin surface exposure by almost 60% compared to that of a diaphragm collimator.

It is desirable that the collimated beam should be contained within a circle having a diameter of 7cm or 2 ¾ inches.

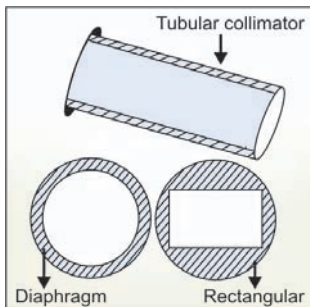


Figure 13.9: Types of collimators

Grids (Figures 13.10A and B)

During a radiographic exposure almost 30% of the scattered photons (formed as a result of Compton scattering) leave the site imaged and exit the body. These scattered photons will result in the formation of dark areas on the radiograph, which interferes with the diagnostic quality of the radiographic image. However, the use of grids increases the patient exposure by two fold. Therefore, grids should be used only when contrast



Figure 13.10: Photograph of a grid

on a radiograph is really necessary. As the grid contains radiopaque absorbing materials, the exposure time has to be doubled when using a grid. If the exposure time is not changed, the resultant radiograph might show multiple thin white lines, which minimize the density of the radiograph. These lines that are seen on the radiographic image are called grid lines (Figure 13.11).

Composition

A grid is made up of alternating strips of lead (radiopaque material) and plastic (radiolucent material) spacers. Grids are made with varying number of pairs of spacer and absorber material for every square inch. Grids with 80 or more line pairs per inch do not show radiolucent grid lines on the resultant image.

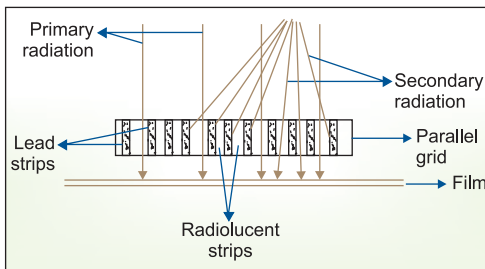


Figure 13.11: Structure of a grid



The effectiveness of the grid is calculated by its grid ratio. Higher the grid ratio, greater is the efficiency of the grid in removing the scattered radiation.

Grid Ratio

It is the ratio of the thickness of the grid to the width of the radiolucent spacer material. A grid ratio of 8 or 10 is most preferred.

Types of Grid

1. Linear grid
2. Focused grid
3. Pseudo focused grid
4. Crossed grid
5. Moving grid or Potter Bucky diaphragm

Functions

Grids are placed between the object to be imaged and the image receptor system (film) to preferentially minimize the amount of scattered radiation reaching the film. Grids reduce film fog from scattered radiation, thereby increasing the contrast of the resultant image.



Radiation Hazards and Protection

Radiation biology refers to the study of the biological effects and hazards associated with x-rays. In early days at the time of discovery of x-rays the harmful effects of ionizing radiation was largely unsuspected. It was Edmund Kells who was one of the early martyrs who fell victim to ionizing radiation. He experienced ten to twelve years of excruciating pain and discomfort as he developed what is known as radiogenic neoplasia. He described it as “unequalled by any other disease”. William Herbert Rollins, a dentist in Boston, developed erythema of his hands following the use of ionizing radiation. He conducted experimental studies on animals and concluded that “x-ray light” would produce burns and even death without burns.

SOURCES OF RADIATION EXPOSURE

The basic sources of radiation exposure can be broadly classified into natural and man-made.

Natural Sources of Radiation

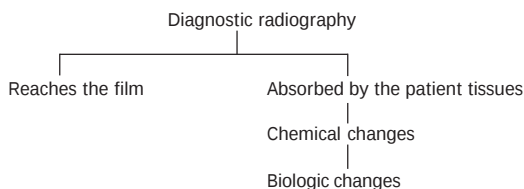
1. Cosmic radiation
 - Primary
 - Secondary
2. Terrestrial radiation
3. Internal sources
 - Inhalation and ingestion of radionuclides

Man Made Radiation

1. Radiation in healing arts
 - Diagnostic
 - Therapeutic
2. Consumer sources of radiation
 - Television receivers
 - Nuclear/coal fired electric plants
 - Air travel
 - Pocket watches

Ionizing radiation affects the living systems by molecular changes that lead to alteration in cells and organisms that persist for hours, decades and possibly even generations. This results in injury or death of the cell or organism. Ionizing radiation damages the nucleic acids, proteins, causes chromosomal aberrations and affects the cell kinetics. Different cells from various organs of the same individual may respond to irradiation differently. The cells with high mitotic rate, or which may undergo many future mitosis and those that are most primitive in differentiation are more radiosensitive.

MECHANISMS OF RADIATION INJURY



The Hazards of ionizing radiation were reported as early as 1897. The biologic effects of radiation are classified into SOMATIC and GENETIC effects.

Somatic Effects of Radiation

Somatic effects are seen in individuals exposed to radiation. Erythema of skin, loss of hair, ulcers, temporary or permanent sterility, teratogenesis by radiation of fetus and radiation induced cancers are few examples for somatic effects.

Genetic Effects of Radiation

Genetic effects are those effects, which are passed on to off springs of individuals whose gonads have been irradiated. Pigmentations of iris, pattern of skin ridges, haemophilia, Down syndrome are few examples for genetic effects.

Precise mechanism of how x-rays cause damaging effects is not clearly known. However, two basic mechanisms are thought to be responsible:

- *Direct damage*: to specific targets within the cell
- *Indirect damage*: to the cell as a result of ionization of water or other molecules within the cell.

X-ray photons → Absorbed by water → free radicals
 Biologic damage ← Cellular damage ←

The damaging effects of ionizing radiation are classified into three main categories

- Somatic non-stochastic effects (definitive)
- Somatic stochastic effects
- Genetic stochastic effects

Somatic Nonstochastic Effects

The damaging effects will have a threshold limit below which there will be no effect. The damaging effects to the person exposed will definitely result from a specific high dose of radiation and the severity of the effect is proportional to the dose received.

Examples: Skin reddening, cataract formation.

Somatic Stochastic Effects

The development of somatic stochastic effects depends on laws of chance or probability. These damaging effects may be induced when the body is exposed to any dose of radiation. The lower the radiation dose, the lower the probabilities of the cell damage and the severity of the damage is not related to the size of the inducing dose. Example: Leukaemia.

Genetic Stochastic Effects

These effects are due to mutations, which result from a sudden change in a gene or chromosome. It can be caused by radiation or may occur spontaneously.

The possible risks inherent in the exposure of an individual or a group of individuals to ionizing radiations is of importance to a variety of groups, including occupational safety experts (nuclear power plant workers) physicians (diagnostic procedures) and patients (routine radiographic screening).

Types of exposure:

- **Accidental:** accidents and explosions involving nuclear power reactors

Example: Nuclear disasters such as destruction of the Chernobyl nuclear reactor

- **Occupational:** chronic low-level exposures of workers whose occupation entails irradiation.

Examples: underground miners, workers at nuclear reactors, radiology personnel

- **Medical:** Individuals with malignancy are at increased risk of developing a second neoplasm.

Example: radiotherapy

The harmful effects of radiation do not show up immediately. There is always a time lag between exposure to radiation and signs and symptoms of biological damage, which is called as latent period. Latent period varies from few hours to years. Length of the latent period depends on the total dose of radiation received and the amount of time it took to receive that dose (dose rate). Higher the dose and shorter the dose rate then the latent period also will be shorter.

Effects of Radiation on Tissues, Organs and Systems

Types

- Early effects (whole body exposure or localized)
- Late effects (cumulative effects)

Early Effects

When an individual is exposed to a high dose of radiation in a short period of time death may occur.

However, low to moderate dose of exposure may cause acute radiation syndrome, which affects haematopoiesis, gastrointestinal system, cardiovascular and nervous system. ARDS is characterised by the following stages:

Stage	Dose	Clinical Features
Prodromal period (minutes to hours)	1-2 Gy	Anorexia, nausea, fatigue diarrhea, vomiting, weakness
Latent period (hours to days)		Patient appears apparently healthy no clinical signs/symptoms
Hematopoietic syndrome	2-1 Gy	Increased susceptibility to infection, hemorrhage and anemia
Gastrointestinal syndrome	7-15 Gy	Diarrhea, dehydration, loss of weight and intestinal ulceration associated with bleeding
Cardiovascular and central nervous system syndrome	>50 Gy	Sudden, steep fall in blood pressure followed by death. CNS involvement causes disorientation and convulsions followed by death

The localized exposure (single dose of 3 to 10 Gy) may affect the skin leading to erythema, loss of skin, desquamation, hair loss, pigmentation of skin and loss of nails.

In dentistry, the size of the doses used routinely is relatively small and well below the thresholds limit. However, somatic and genetic stochastic effects can develop with any dose of ionizing radiation and hence these are of most concern.

The critical organs that are of concern are:

Skin

During exposing dental films, dose to skin of face is around 10 mgy. Hence, patient needs at least twenty five series of full mouth intraoral periapical radiographs to increase the risk of skin cancer.

Lens of the Eye

It requires over 2 Gy (2000 mgy) to develop cataracts. Dose to eye from a full mouth intraoral radiographic series is around 0.6 mgy.

Thyroid Gland

The required dose for thyroid cancer is around 0.05 Gy (50 mgy). The dose to the thyroid from a full mouth intraoral radiographic series is around 0.25 mgy.

Reproductive Cells

Doses below 100 mgy are safe on the fetus. From dental radiography the dose to reproductive cells will be 0.0005 mgy. With the use of lead apron the dose will be around 0.0001 to 0.0003, which is virtually zero exposure.

Radiosensitivity of Various Constituents of the Human Body

Following table compares the different types of radiosensitive cells.

<i>Highly radiosensitive</i>	<i>Moderately radiosensitive</i>	<i>Minimally radiosensitive</i>
Lymphoid organs	Fine vasculature	Optic lens
Bone marrow	Growing cartilage	Mature erythrocytes
Testes	Growing bone	Muscle cells
Intestines	Salivary glands	Neurons
Mucous membranes	Lungs, Kidney, Liver	

The following table compares the risk of radiation induced malignancy.

<i>X-ray examination</i>	<i>Risk per million of a fatal cancer</i>
Intraoral radiography	0.2
Chest (male)	0.27
Chest (female)	0.47
Orthopantomography	1.0
Skull radiography	1.7
Lumbar spine	2.5
Pelvis	3.9
Abdomen	9.5
Barium meal	26
Barium enema	37
CT lung (male)	198
CT lung (female)	395

Ionizing radiation used for dental radiographs has proved to be relatively safe but the biologic effects of ionizing radiation can be extremely damaging. Therefore, it is necessary to keep all exposures as low as reasonably achievable for both patients and dental staff.

RADIOTHERAPY AND ITS EFFECTS ON ORAL TISSUES

Radiotherapy for the treatment of neoplastic disease in the head and neck region results in a number of oral changes that can result in discomfort and pain. Patients undergoing radiotherapy are more susceptible to caries and periodontal diseases. When a small number of cells are lost due to radiation there will be no clinical effect. However, with an increased number of cells lost the effected individual will show clinical changes. Oral cavity irradiated during the course of treating oral malignant tumors (squamous cell carcinoma) has shown deterministic effects. Radiotherapeutic doses of radiation to head and neck region is about 40 to 50 Gy which may be fractionated and controlled. Following changes may be seen in the oral tissues when radiotherapy is used for treating oral squamous cell carcinoma.

Oral Mucous Membrane

Basal layer of oral mucous membrane is composed of radiosensitive differentiating cells. At the end of the second week the mucous membranes show redness and inflammation due to death of some cells. This is clinically termed as mucositis. This is due to decreased mitotic activity and subsequent longer retention of the superficial cells, allowing them to become highly keratinized. As these cells are lost and they are not replaced in sufficient numbers by the underlying epithelium, the mucosa becomes red and atrophic. As the therapy continues a yellow pseudomembrane composed of desquamated epithelial cells is formed. Opportunistic infection by candida albicans is seen. Patient may complain of discomfort, burning sensation and difficulty in swallowing.

Long-term atrophy results from progressive obliteration of the fine vasculature and fibrosis of the underlying connective tissue, this results in atrophic thin and relatively avascular tissues. Oral ulcers particularly in denture wearer are the most common complication. Radiation mucositis is a relatively short-term complication and resolves within two or three weeks after radiotherapy is completed.

Taste Buds

Patients may often complain of loss of taste by the second or third week of radiotherapy. Bitter and acid flavors are affected when posterior two thirds of the tongue is irradiated, salt and sweet when the anterior one third is irradiated. Taste acuity gets more complicated with loss of saliva secretion. Irradiation causes degeneration of the histologic architecture of the taste buds as they are very sensitive. Recovery to near normal level takes place by about 60 to 120 days after irradiation.

Salivary Glands

In the first few weeks of radiotherapy patients may complain of dry mouth, difficulty in swallowing and burning sensation as a result of decreased salivary secretions. The effect of radiation on the salivary gland can be very rapid and it has been shown that only 14 hours after administration of 2 Gy there can be 50% reduction in the resting flow of parotid saliva. Major salivary glands invariably get irradiated due to their anatomical position during radiation therapy of the oral cavity. The extent of the reduced salivary flow is dose dependent and reaches zero at 60 Gy. Fall of the salivary pH to 5.5 (normal being 6.5) initiates decalcification of the enamel. This leads to radiation caries and also affects the normal oral microbial flora. *Streptococcus mutans*, *Lactobacillus* and *Candida* have been found to increase in numbers in patient receiving radiation therapy. The parenchymal component of the salivary glands is radiosensitive. Mucous acini are less sensitive to irradiation. Serous acini will show acute inflammatory response after initiation of the therapy. In the following months the inflammatory response becomes chronic

and glands show fibrosis, loss of fine vasculature, adiposis and parenchymal degeneration, resulting in xerostomia. If some portions of the major salivary glands have been spared, dryness of the mouth usually subsides by 6 to 12 months because of the compensatory hypertrophy of residual salivary gland. If the reduced salivary flow persists beyond a year it is unlikely to show any significant recovery.

Teeth

Mature teeth are resistant to irradiation. There is no effect on the structure of enamel, dentin and cementum and radiation does not increase their solubility. Dose as low as 0.05C/Kg (200R) at the age of five months is sufficient to develop hypoplastic enamel. Dental pulp consists of radio resistant reverting or fixed post mitotic cells and may show fibro atrophy after irradiation. However if irradiation precedes calcification, it may destroy the tooth bud. If it is after calcification it may show malformations, dwarfed teeth, defective root formation or failure to form one or more teeth. It may be also noted that eruptive mechanism of teeth is relatively radio-resistant.

Radiation Caries

It is a form of a rampant caries following radiation therapy. It follows a rapid course and with a widespread attack. The term radiation caries is a misnomer because caries occurs secondary to changes in the characteristics of saliva. Carious lesions are caused following an exposure of salivary glands to radiation which in turn reduces the salivary flow, decreases the pH, reduces the buffering capacity, and increases the viscosity of saliva. Cleansing activity of saliva is reduced and debris accumulates quickly that leads to rampant caries.

Types of Radiation Caries

Clinically three different types of radiation caries exist:

1. Widespread superficial lesions involving incisal palatal, occlusal and buccal surfaces. This is the commonest type.

2. Primarily involves the cervical region of the teeth and involves the cementum and dentin. The carious lesion progresses circumferentially around the teeth and finally the crown amputates. This is also known as amputation caries or apple core pattern of caries destruction.
 3. Appears as a dark pigmentation of the entire crown. Incisal edges will be markedly worn out.
- Combination of these lesions may also be found.

Bone

Irradiation of the bone leads to one of the most serious complications known as osteoradionecrosis. Risk of osteoradionecrosis increases with higher dose of radiation. Bone dose exceeding 65 Gy (6500 rads) is required for osteoradionecrosis to develop. It is more commonly seen in mandible because it is more frequently irradiated and maxilla has a rich vascular supply compared to mandible.

It is primarily due to radiation, trauma and infection. The marrow tissue becomes hypovascular, hypoxic and hypocellular. Bone infection may result from radiation-induced break down of the oral mucosa by mechanical damage due to a denture, tooth extraction, periodontal disease or through a carious lesion.

Osteoradionecrosis



Hypovascularity $\Rightarrow$ Hypoxia $\Rightarrow$ Hypocellularity
("3 H" Principle)

Irradiation of the bone results in damaging the vasculature of the periosteum and cortical bone. It also destroys the osteoblasts and to a lesser extent osteoclasts. The normal marrow may be replaced with fatty marrow and fibrous connective tissue. Endosteum becomes atrophic and lacunae of the bone may show necrosis. The degree of mineralization will be reduced leading to brittleness that finally results in bone death.

MANAGEMENT

Oral care prior to radiation therapy can reduce the complications of radiation-induced damage. The following guidelines are recommended:

- Thorough clinical examination must be carried out to detect the carious, periapical and periodontal lesions. Diagnostic radiographs to supplement the clinical examination should not be postponed, as the radiation dose is very negligible.
- Restoring all carious lesions prior to radiation therapy can minimize radiation caries.
- Periodontally weak teeth should be extracted and sufficient time should be given for the extraction wounds to heal. Atraumatic extraction technique to be instituted during extraction. Care can be taken by avoiding to elevate the periosteum and using low concentration of epinephrine-containing local anesthetics that do not contain lidocaine.
- Dentures should be adjusted to avoid denture sores. All irregularities and sharp areas of restoration are smoothed down to avoid irritation.
- Use of 10 ml of 2% chlorhexidine gluconate mouth rinse is recommended in dentate patients to maintain a relatively plaque free mouth.
- Patients are advised to avoid flavouring agents including those in toothpastes and mouth rinses.
- Application of 1% neutral sodium fluoride gel daily for five minutes in custom made applicator trays. This helps in delaying radiation-induced elevation of *Streptococcus mutans* asking the patient to avoid dietary sucrose. In addition, will reduce the concentration of *Streptococcus mutans* and *lactobacillus*.
- Use of systemic prednisone (40 to 80 mg) but not for more than one week can be used for mucositis.
- Mouth rinse with benzydamine hydrochloride and or with magnesium hydrochloride and oxethazaine (Mucaine) is recommended for mucositis.

- Viscous xylocaine can also be used for local application.
- Zinc supplement (dosage 20 mg/day) can be used to improve the taste acuity. Patient may be instructed to give up sugar in tea or coffee before radiotherapy is started.
- Pilocarpine hydrochloride 5 mg three to four times per day can be recommended to counteract xerostomia.
- Avoid taking radiographs for about six months after completion of radiotherapy to allow the mucosal membrane to heal.
- Patient should be made aware of the acute oral side effects of radiotherapy so that they know what to expect. Otherwise, they invariably conclude that their reactions are unique and abnormal.
- Patient to be educated and motivated to maintain good oral hygiene.

PROTECTION AGAINST RADIATION HAZARDS

Radiation Measurements

Dosimetry is the measurement of quantity of radiation exposure or dose. It can be measured only by measuring an effect produced by X-rays. International commission on Radiation Units and Measurements, ICRU established units for measurement of radiation. There are two systems namely:

1. Traditional or standard system.
 2. SI or System Internationale units
- There are three quantities of radiation.

1. Exposure
2. Dose
3. Dose equivalent

EXPOSURE

It is a measure of the ability of radiation to produce ionization in air under standard conditions of temperature and pressure.

Units of Exposure

Traditional unit – Roentgen (R)

SI units – Coulombs/kg (C/kg).

Roentgen: It is the amount of X-radiation or gamma-radiation that produces 2.08×10^9 ion pairs in/cc of air under standard temperature and pressure.

$$1 \text{ R} = 2.58 \times 10^{-4} \text{ C/kg.}$$

Absorbed dose

It is the measure of energy absorbed per unit mass of a tissue or site of interest.

Units of absorbed dose

Traditional unit—rad (Radiation absorbed dose)

SI unit—gray (Gy)

1 rad = 100 ergs/g of the absorber

1 Gy = 100 rads or 1 joule/kg

Dose equivalent

This term is used to compare biologic effects of different types of radiation.

Units of dose equivalent

Traditional unit—rem (Roentgen equivalent man)

SI unit — Sievert (SV)

1 sievert = 100 rem

Techniques for Measuring Radiation Exposure

Film badges, thermoluminescent dosimeters and ionization chambers are used to assess the radiation exposure.

Film Badges

Film badges are used to monitor exposure of individuals to x-rays. They are worn either on the wrist or chest. They are made of a plastic cassette that encloses a radiographic film. The outer surface of the cassette has six windows, each covered by a different substance such as plastic, lead, copper and cadmium of varying thickness. The film is processed after a specified interval and the extent of exposure is measured by degree of darkening of the film (Figure 14.1).

Ionization Chambers

They consist of a pair of collecting plates. These plates are separated by a standard volume of air. The plates are connected to a device termed electrometer which can measure minute amounts of electric charge.

Before the instrument is employed a standard charge is applied to the plates. When the x-ray beam is directed through the air in the ionization chamber, ion pairs are generated.

The positive and negative ions produced by the radiation will be attracted to the plates of opposite charge and cause a partial discharge.

The magnitude of x-ray exposure is therefore expressed as a function of number of ions produced and measured by the magnitude of the drop in potential between the collecting plates.

Thermoluminescent Dosimeters (TLD Badges)

Principle: All crystals absorb energy when exposed to radiation. This energy will be released when the crystal is heated which is detectable in the form of visible light which in turn is measured with a photo multiplier tube. The energy is trapped by the impurities seen in the crystals. The crystals used are Lithium Fluoride (LiF) and Calcium fluoride containing manganese (Figure 14.3).

Advantages: Small size, accuracy (LiF has absorption characteristics similar to soft tissues) and easy handling.

RADIATION PROTECTION

Patient Protection

- i. Prior to Exposure
 - a. Prescribing dental radiographs.
 - b. Proper equipment.

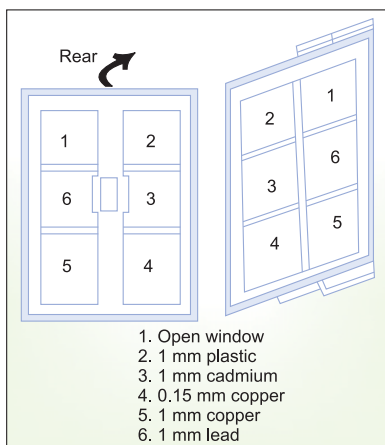


Figure 14.1: Film badge

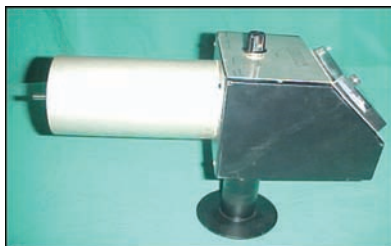


Figure 14.2: Photograph showing ionization chamber



Figure 14.3: Photograph showing TLD badge

- ii. During exposure:
 - a. Protective shields.
 - b. Film.
 - c. Exposure variables.
 - d. Techniques.
- iii. After exposure
 - a. Film handling.
 - b. Film processing.

Operator Protection

1. Operator protection guidelines.
2. Radiation monitoring.

Protection of other people

1. Designing the radiology room.
2. Construction of radiology room.

Prescribing Dental Radiographs

- Radiographs should be prescribed for a patient only when the benefit of disease detection outweighs the risk of biologic damage.
- Professional judgement of the dentist should be used to make decisions about the number, type and frequency of dental radiographs.

Patient exposure and dose: The amount of exposure from radiography depends on

1. *Film speed:* Faster the film less will be the exposure. Use of E-speed instead of D speed will reduce the absorbed dose by 50%.
2. *Collimation:* Radiation exposure can be reduced by rectangular collimation, which will reduce the absorbed dose by 60~70% when compared to round collimation.
3. *Technique:* Long cone paralleling technique and long source to film distance reduces the skin dose.
4. *Exposure factors:* Higher kilovoltage peak will reduce the skin dose.

Patient Protection

Prior to Exposure

1. Patient selection
 1. Proper prescribing of dental radiographs.
 2. Professional judgement should be used to decide the number, type and frequency of dental radiographs.
Radiographic selection criteria: Radiographic selection criteria (High-yield or referral criteria) are clinical or historical findings that identify patients for whom there is a high probability that a radiographic examination will provide information that will affect their treatment and prognosis.
 3. Radiographic examination should never be with predetermined number or time interval and it should be done only after clinical examination and consideration of both the dental and general health needs of the patient.
 4. Guidelines for prescribing the number, type and frequency of dental radiographs by ADA and FDA. This is for patient protection in diagnostic radiography.
 5. Oral radiographic examination is not contraindicated in pregnancy if it is necessary.
2. Proper equipment (Choice of equipment)

Receptor selection: The basis for selecting films, film-intensifying screens combinations and other image receptors should be to obtain maximum sensitivity (speed) consistent with the image quality required for the diagnostic task.

Intensifying screens: These are mainly used for extraoral radiography. It has been shown to reduce the exposure by 90% of D speed films but they are yet to be used for intraoral radiography. When green sensitive films are used with rare earth screens (using Lanthanum or Gadolinium), they are eight times more sensitive than conventional screen of Calcium tungstate with blue sensitive films.

T-grain film (T-mat by Kodak): They have a flat surfaced silver halide grains with greater cross section.

Filtration

This is of two types—inherent and added.

Inherent filtration: Occurs when primary beam passes through the glass window of the X-ray tube, insulating oil and tube head seal. It is almost equivalent to 0.5 to 1.0 mm of Aluminium (AL). This alone is not sufficient to meet the requirement Hence added filtration is required. X-ray energies most effective in producing the image are between 35 and 55 keV.

Added filtration: This is by the placement of Al disks in the path of X-ray beam between the Collimator and tube head seal. It is added in the increments of 0.5 mm. Filters low energy X-rays, results in higher energy, more useful beam. Selective filtration for low and high energy has been demonstrated by rare earths like erbium, yttrium, niobium, etc. This will result in increase in exposure time, movement of patient during exposure, decrease in contrast. Total filtration: This includes both inherent and added filtration.

The required filtration should be minimum of:

for machines ≤ 70 kVp is 1.5 mm Al

for machines > 70 kVp is 2.5 mm Al

Collimation

It is used to restrict the size and shape of the X-ray beam and to reduce the patient exposure. Consists of lead plate with a aperture in the middle. It is fixed directly over the opening of the machine housing where X-ray beam exists the tube head. It is of two types, round-shaped beam of 2.75" in diameter, and rectangular. In the rectangular type the X-ray beam size is slightly larger than size 2 intraoral film.

Collimation will result in decreased patient exposure as well as increased image quality due to decrease in scatter (decreased fog).

Position Indicating Device

It is an extension of the X-ray tube head and is used to direct the X-ray beam.

It is of three types (Figures 14.4A and B)

- a. Conical–Closed, pointed plastic cone that produces scattered radiation.
- b. Rectangular–Most effective in reducing patient exposure.
- c. Round

The rectangular and round collimators are lead lined, hence there is no scattered radiation.

Focal spot to film distance: It is shown that with larger FSFD, the thyroid dose has decreased. Larger FSFD also decrease the exposed tissue volume, by less divergence of the beam and also increasing the resolution due to decrease in focal spot size. Rectangular and round PIDs can again be:

- a. Short (8 inch)
- b. Long (16 inch) - preferred due to less divergence of beam, which are harmful and are not diagnostically useful. Filtration During exposure:

Protective shields: It includes thyroid collar, lead apron, etc.

- Thyroid collar is a flexible lead shield placed around the patient's neck to protect the thyroid gland from scatter radiation since thyroid tissues are highly sensitive (Figures 14.5A and B).
- Can also be a part of lead apron.
- Recommended for all intraoral films. Not for extraoral films as it obscures information on the film.

Lead apron: Flexible shield placed over the patient's chest and lap to protect reproductive and blood forming tissues from scatter radiation. Recommended for all intra and extraoral films (Figure 14.6).

Film Variables

Fast film: Single most effective method to reduce patient exposure. Available for both intra and extraoral radiography. Increase in sensitivity (speed) will lead to possible decreased image quality due to increase size of silver halide crystals. E speed (Ekta) is the fastest intraoral film. D-speed (ultra) was used before. E speed is twice as fast as D speed, requires only half the exposure time. It is 50 times faster than regular dental



A



B

Figures 14.4A and B: Photograph showing pointed and round cone



A



B

Figures 14.5A and B: Photographs showing different types of thyroid collars



Figure 14.6: Photograph showing lead apron

X-ray films used in 1920s, which needed about 9 seconds of exposure.

Film holding devices: FHDs stabilize the film position in the mouth and reduces the chances of movement. There is no need for patient to hold the film, hence unnecessary radiation to patient's fingers is avoided.

Exposure Factors

kVp: 70-90 kVp keeps patient exposure to minimum. Kilovoltage controls the energy of the beam. Decrease in kVp causes increase in contrast. Low contrast is to differentiate small differences in density. Some units have preset kVp and mA settings. High contrast is used to differentiate areas with large differences in contrast like soft tissue calcifications. High kVp means decrease in effective dose per intraoral examination. Milliamper-Seconds (mAs): Image density is controlled by quantity of x-rays produced which in turn is controlled by mA and exposure time.

Photo timing: Using photo diodes, which automatically switches off when the quantity of radiation reaching the film is adequate.

Proper technique: Helps to ensure the diagnostic quality of films and reduce the amount of exposure a patient receives by avoiding retakes. Through knowledge of techniques are necessary. The three commonly used intraoral techniques are paralleling, bisecting and bitewing.

After Exposure

Proper film handling: Artifacts may be produced resulting in non-diagnostic films and may need a retake.

Proper film processing: Improper film processing will render the film non-diagnostic requiring retakes thereby needlessly exposing the patient. Time-temperature processing is the best way to assure optimum film quality.

Interpretation of the image: Radiographs should be viewed with even back lighting. This can be achieved by seeing the

film with an illuminated viewer in a semi-darkened room with light passing only through films. Magnifying glass can be used to see the changes in density. Variable intensity can also be used.

Operator Protection

Operator Protection Guidelines

The basic rule is the “radiographer must avoid the primary beam.” Distance recommendations:

- Avoid primary beam.
- Stand at least 6 feet away from x-ray tube head at an angle of 90° to 135° to the central x-ray beam.
- Protective barrier to be used.

Position recommendations

- Radiographer must be positioned either perpendicular to the beam or at 90-135° angle to the beam.
- Never hold a film in place for a patient during exposure (Figure 14.7).
- Never hold the tube head during exposure.

Shielding Recommendations

Protective barriers that absorb primary beam should be incorporated to avoid scatter radiation.

- Operator should stand behind a protective barrier (Figure 14.8).

Radiation Monitoring

- a. Equipment monitoring
- b. Personnel monitoring

Equipment Monitoring

- For leakage.
- Leakage radiation is any radiation, with exception of primary beam that is emitted from the tube head.
- Monitoring can be done by using a film device.

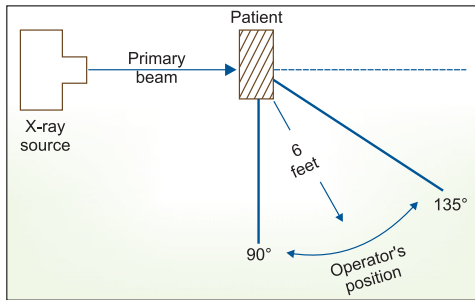


Figure 14.7: Position of the radiographer in the absence of the lead screen



Figure 14.8: Photograph showing lead screen placed six feet away from the x-ray source

Personnel Monitoring

- Using a personal monitoring device (Film badge.)

Film Badge

- Can be obtained from a film badge service company.
- It is a piece of radiographic film in a plastic holder.
- It is a personal item and should be worn at waist level.

- When not worn, should be stored in a radiation safe area.
- Should never be worn when the operator is undergoing x-ray exposure.
- After a specific interval, badge is returned to service company and they will process and evaluate the film for exposure and provide an exposure report.

RADIATION EXPOSURE GUIDELINES

Maximum Permissible Dose (MPD): It dictates the maximum dose of radiation an individual can receive.

MPD is defined by the NCRP as the maximum dose equivalent that a body or specified parts thereof is permitted to receive in a specific period of time. It is expressed in sieverts to include both particulate and electromagnetic ionizing radiation.

MPD is the dose of radiation the body can endure without injury. At MPD risk is not zero but it is consistent with the risks of other occupation.

Current MPD for occupationally exposed persons is 5.0 rem/year and for non-occupationally exposed persons is 0.5 rem/year. For pregnant women; 0.5 rem/year.

Whole body MPD is $20 \text{ mSv/year} = 2 \text{ rem/year}$

Radiation exposure guidelines follow the ALARA Concept: As Low As Reasonably Achievable. It states that all radiation exposure should be kept to a minimum. The present thinking is ALAPA, which refers to As Low As Possibly Achievable.



Image Receptor Systems

IMAGE RECEPTORS USED FOR DENTAL RADIOGRAPHY

When x-rays pass through the object they carry information and this information is recorded on an image receptor (radiographic films) in the form of latent (invisible) image.

Image receptors used for dental radiography can be broadly divided into:

Based on the Placement of image receptor

1. *Intraoral films*—the film is placed inside the mouth
2. *Extraoral films*—the film is placed out side the mouth

Based on the Character of the Image receptor

1. *Direct action films or non screen films (intraoral films)*- primarily sensitive to x-rays, do not contain intensifying screens
2. *Indirect action films or screen films (extraoral films)*-film placed between intensifying screens, primarily sensitive to light photons emitted by the intensifying screens.

INTRAORAL FILMS (DIRECT ACTION OR NON-SCREEN FILMS)

Intraoral films are used when the area to be imaged is minimal. It shows the area imaged with a high resolution and great image clarity. Minute anatomic details can be viewed on an intraoral radiograph.

Types of Intraoral Radiographs (Figure 15.1)

Based on the area imaged intraoral radiographs can be divided into

1. Intraoral periapical radiographs
2. Bitewing radiographs
3. Occlusal radiographs (maxillary and mandibular)



Figure 15.1: Photograph showing different sizes of intraoral films

Intraoral Periapical Radiographs (IOPAR)

Like the name suggests these radiographs are taken to evaluate the crown and root of a tooth and the periapical regions surrounding the tooth.

Sizes

IOPAR films are available in three sizes.

Size 0 – (22 mm × 35 mm) used for child patients.

Size 1- (24 mm × 40 mm) these narrow films are used for imaging adult anterior teeth

Size 2- (31 mm × 41 mm) standard films that are used for imaging adult posterior teeth

However when size 1 films are not available the size 2 adult film can be placed vertically and used for imaging adult anterior teeth. It should be noted that these films could be used interchangeably between adults and child patients. The radiographer should take into consideration various features such as the mouth opening, frenal attachments, vestibular depth and anatomic/pathologic variations while taking a radiograph before choosing the appropriate film size.

Indications

1. Evaluation of the extent of dental caries.
2. Detection of periapical infection/inflammation.

3. Cysts associated with periapex, lateral margins and occlusal portions of impacted teeth.
4. Fractures of teeth and alveolus.
5. Preoperative and Postoperative assessment for endodontic and periapical surgery.
6. Assessment of root morphology prior to dental extractions (dilacerations, multiple roots, ankylosed root tips).
7. Assessment of unerupted and impacted teeth.
8. Postoperative evaluation of implants.
9. Assessment of periodontal status.

BITEWING RADIOGRAPHS

These radiographs are taken either using commercially available bitewing holder or can be made in the dental office using a stiff sheet of paper/card board. The fabricated holder is essentially a tab or a wing, made of radiolucent material, which protrudes from the center of the film packet on which the patient is instructed to bite.

Size

Routinely adult size 2 IOPAR film is used for taking bitewing radiographs. However size 1 can be used in very older children and size one can be used in children.

In some instances a longer film (size 3) is used in adults, which measures 53 × 26 mm.

Indications

1. Detection of initial proximal caries
2. Assessment of gingival overhangs of proximal restorations
3. Assessment of crestal alveolar bone loss
4. Pulpal calcification in the coronal portion of the pulp (incidentally noticed)
5. Assessment of contours of ill-fitting crowns.

Occlusal Radiographs

It provides a bird's eye view of the dental arches. It is a right angled view of the image obtained by an intraoral periapical radiograph. An occlusal radiograph is taken by placing the commercially available occlusal film in the occlusal plane. Based on the arch that is imaged, it is referred to as maxillary or mandibular occlusal radiograph.

Size

The occlusal film measures 57×76 cm in dimension. It is three times larger than a size 2 IOPAR film.

Indications

1. To identify the anatomic location of the impacted tooth, whether placed lingually or buccally
2. Assessment of expansion of cortical plates caused by intraosseous lesions
3. Assessment of fractures of alveolar bone and teeth of the anterior region.
4. Evaluation of the submandibular salivary gland and duct for presence of sialolith
5. To estimate the extent of large periapical lesions esp. involving anterior teeth.

CONTENTS OF AN INTRAORAL FILM PACKET (FIGURE 15.2)

Intraoral film packets are made up of the following constituents.

1. Outer protective jacket
2. Lead foil
3. Black colored paper wrapper
4. Film

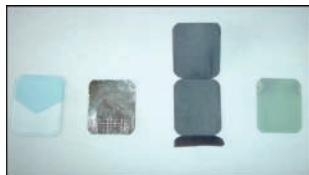


Figure 15.2: Photograph showing contents of an intraoral film packet

Outer Protective Jacket

The outer protective jacket is light proof and moisture proof. The jacket is sealed to prevent the entry of light and ingress

of oral fluids when placed in the mouth. The outer jacket is usually twin colored. One side of the film is white, which faces the x-ray tube head and the opposite side which is generally twin colored and has a flap which is used to open the film during processing.

The outer jacket is incorporated with a raised dot, which relates with a similar area on the dental film inside the packet. The raised dot is on the white colored surface of the protective jacket and this dot helps in orientation of the film during the exposure. Once the film is processed the orientation of the raised dot is used to identify the left and right side of the patient.

Once the outer jacket is peeled holding the flap side of the outer jacket, the thin sheet of lead foil comes into view. This lead foil has parallel indentations or markings along the surface in one corner of the foil. If the film is exposed placing the wrong side towards the tube head, these markings are seen on the resultant radiograph. If the wrong side of the film is exposed, though the radiograph will reveal an image, the image will appear light. The markings on the film will help one identify the cause for the underexposed or light radiograph. These markings on the resultant radiograph are referred to as *Tyre mark pattern* or *Herring bone pattern*.

The reasons for placing a lead foil within the film packet are the following

- a. In the absence of the lead foil x-rays will pass through the film and interact with the tissues beyond the film and reflect back leading to multiple exposures thereby minimizing the quality of the final image.
- b. It will minimize exposure of the patient's tissues, which are in line with the x-ray beam but beyond the imaging area. In the absence of the lead foil, x-rays will pass through the film and expose tissues beyond the film.

Once the lead foil is folded back, the black paper wrapper is seen in which the film is placed. The paper wrapper protects the film from extraneous visible light and protects the emulsion of the dental film during handling and storage.

The film has a raised dot on one side and the other side has a small concave depressed area. The hanger used for

processing is clipped onto the film conforming to the depressed shallow concave area. This allows a one-point contact between the clip and the film. The advantage of this one point contact is that processing solutions freely flow into the shallow depression on the film thereby exposing every single area of the film. Care should be taken to ensure that the clip is always placed in the concave spot on the film.

Composition of Intraoral Film (Figure 15.3)

Intraoral films are made up of two principal components namely *emulsion* and the *base*.

Emulsion

The emulsion is sensitive to x-rays and visible light. The emulsion is composed of a vehicle matrix which holds the silver halide grains and trace amount of sulfur compounds and gold so as to enhance the sensitivity of the silver halide grains to x-rays.

- a. *Silver halide grains*: Silver bromide makes up most of the silver halide grains that are incorporated in the emulsion. However, silver iodide is added in small quantities as they have crystals of larger diameter which helps in increasing the sensitivity of the film.
- b. *Vehicle matrix*: The vehicle matrix helps in the even distribution and dispersion of the silver halide grains. It is made up of gelatinous or nongelatinous substances.

Base

The base of the intraoral film is made up of polyester polyethylene terephthalate and is about 0.22 mm in thickness. It is believed

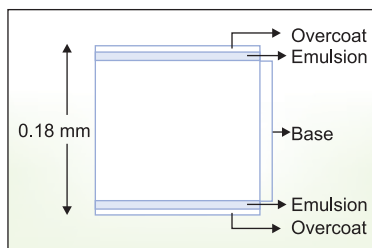


Figure 15.3: Composition of intraoral film

that a blue tinted base will improve the viewing characteristics of the radiograph.

Requirement of an ideal base

1. It should support the emulsion
2. It should have enough flexibility to enable easy handling of the film
3. It should be uniformly translucent and should not hamper the diagnostic quality of the film
4. It should be able to withstand the effects of the chemicals in the processing solutions

An adhesive is usually applied in between the emulsion and base to improve the adhesion between the two. An additional layer of the gelatinous substance is added to the film emulsion, which is referred to as an *overcoat*. It protects the film from scratching or contamination of the film during handling or contact with the processing tanks and it also protects the film from the pressure of rollers of an automatic processor.

INDIRECT ACTION FILMS/SCREEN FILMS/EXTRAORAL FILMS

These films are called screen films as the radiographic film is placed between two intensifying screens within a cassette. Screen films are employed in extraoral radiography such as Orthopantomogram, Lateral cephalogram, Skull views, TMJ views, and Lateral oblique views of the mandible (Figure 15.4).

Cassette: Cassettes are light tight containers, which help in maintaining an uniform and intimate contact between the film and the intensifying screens. Cassettes are available in various sizes and shapes conforming to the various sizes of radiographic film (6 × 8 inches, 8 × 10 inches and 5 × 10 inches). They are usually made of plastic or thin metal (Figure 15.5).

Basically extraoral film cassettes are available in two specifications: Rigid and Flexible cassettes.

Rigid cassettes: They are made of thin metal framework. The surface on the exposure side is made up of plastic and the non-exposure surface has metal clamps, which help in locking

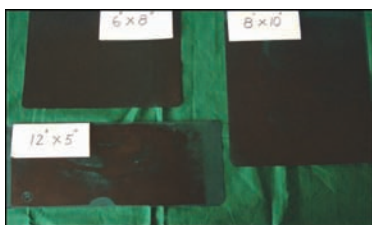


Figure 15.4: Photograph showing extraoral films

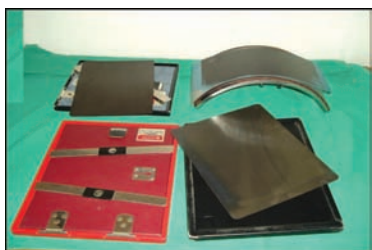


Figure 15.5: Photograph showing extraoral cassettes

the cassette so as to ensure an intimate contact between the film and the intensifying screens. Rigid cassettes are easy to handle and protect the screen, however they are expensive and may break on impact.

Flexible cassettes: They are made up of flexible plastic and used for Orthopantomography. They are delicate and may tear with regular use. They are also difficult to load and unload in the darkroom setting. However they are comparatively cheaper than rigid cassettes and require less room for storage.

Intensifying screens: Intensifying screens are used in pairs and are positioned on either side of a double emulsion film (Figures 15.6 and 15.7).



Figure 15.6: Photograph of an intensifying screen

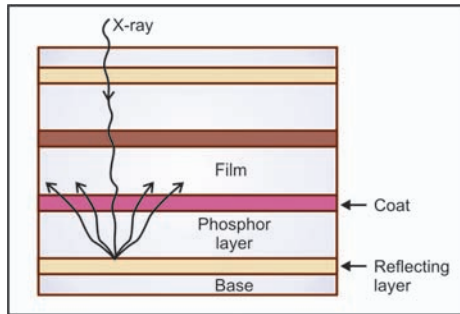


Figure 15.7: Composition of intensifying screen

Composition of Intensifying Screen

Intensifying screens are made of four principal components: The base, reflecting layer, Phosphor layer and the coat.

Base: The base of the intensifying screen is made up of the same material that is used in an intraoral film, i.e. polyethylene terephthalate. The base is usually 0.25 mm in thickness. The base acts as a supportive material.

Reflecting layer: It is made up of Titanium dioxide. It is placed between the base and the phosphor layer. It helps in reflecting back on to the phosphor layer any light that is emitted by it. However, the reflecting layer may add to the unsharpness of the resultant image.

Phosphor layer: Radiosensitive phosphor salts are incorporated into this layer of the intensifying screen. Inorganic salts such as Calcium tungstate, Zinc sulfide, and Zinc cadmium sulfate are some of the salts that are used. The presence of these salts has led to the naming of intensifying screens as *Salt Screens*.

However, rare earth materials are used these days. These rare earth materials are Terbium activated gadolinium oxysulphide and Thulium activated Lanthanum oxybromide.



Coat

The coat is made up of plastic and has a thickness of 8 micrometers. It provides protection to the underlying phosphor layer. As the coat is made up of plastic it can be easily cleaned. It should be ensured that the coat is free from scratches and dirt.



Projection Techniques

INTRAORAL TECHNIQUES

Teeth and the surrounding structures can be imaged using intraoral radiographs. Intraoral imaging includes periapical radiography, bitewing radiography and occlusal radiography. Periapical radiograph reveals individual teeth and the structures around the apices. Ideal periapical radiograph shows two or four teeth and provides detailed information about the teeth, their apices and the surrounding alveolar bone.

Intraoral radiographs are placed in the area of interest using commercially available film holders like “Snap- a –ray” film holder (Figure 16.1) in bisecting angle technique. Intraoral films can also be held using mosquito forceps (Figure 16.2). Rinn XCP (Extension cone parallel) holders (Figure 16.3) are used for paralleling technique. Bitewing radiographs can be taken using either commercially available film holders (Figure 16.4) or holders that can be made using stiff paper (Figure 16.5).

INTRAORAL PERIAPICAL RADIOGRAPHS

Indications for Periapical Radiographs

- To detect periapical inflammation and infections.
- To assess periodontal status.
- To evaluate alveolar bone and teeth following trauma
- To assess the root morphology before extractions.
- To assess the presence and position of unerupted teeth.
- In endodontics



Figure 16.1: Photograph showing Snap a ray film holder



Figure 16.2: Photograph showing mosquito forceps used as a film holder



Figure 16.3: Photograph showing Rinn XCP film holder

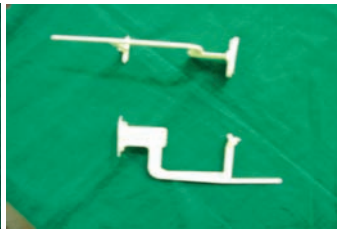
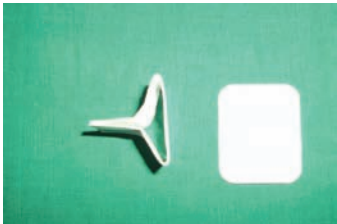


Figure 16.4: Photograph showing bite wing holder



A



B

Figure 16.5: Photograph showing paper tab being used to hold a bite wing film

- Preoperative and postoperative evaluation of periapical surgeries.
- To evaluate implant position.

BASIC PRINCIPLES OF INTRAORAL PERIAPICAL RADIOGRAPHY (Figure 16.6)

- The object of interest that is to be radiographed should be positioned between the X-ray source and the film.
- The tooth and the film packet should be as close as together as possible
- The tooth and the film packet should be parallel to one another.
- The X-ray beam must be at right angles to the film and the object.
- The X-ray source should be at an optimal distance.

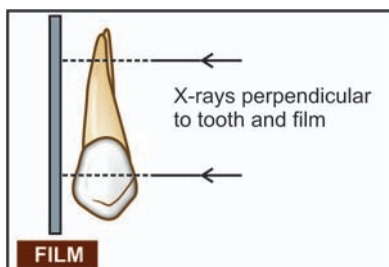


Figure 16.6: Ideal tooth- film relationship

The anatomy of the oral cavity does not allow following all the ideal requirements while radiographing the teeth and the surrounding structures. The curvature of the palate, shallow vestibular sulcus limits the positioning of the film in an ideal position. To overcome the problems two techniques for periapical radiography have been developed.

TECHNIQUES THAT ARE USED FOR TAKING INTRAORAL PERIAPICAL RADIOGRAPH (IOPAR)

- Bisecting angle technique or short cone technique
- Paralleling technique or long cone or right-angle technique

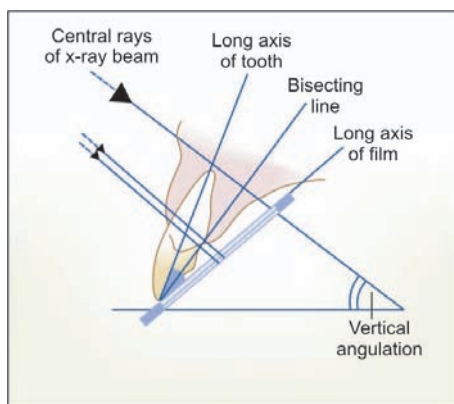


Figure 16.7: Bisecting angle technique

Bisecting Angle Technique (Figure 16.7)

In this technique the film is placed as close as possible to the tooth that has to be imaged. The central ray of the X-ray beam is projected perpendicular to an imaginary bisector that bisects the angle formed by the long axis of the tooth and long axis of the film.

Bisecting angle technique is based on Cieszynski's law of isometry, which states that, two triangles are said to be equal when they share one complete side and have two equal angles.

General Guidelines

- Describe the procedures of taking the radiograph to the patient and try not to avoid to comment on any discomfort it may cause. This helps in handling the patients who are very apprehensive.
- Ask the patient to remove eyeglasses and all removable prosthetic appliances and ornaments in the imaging field.
- Drape the patient with a lead apron
- Position the patient upright in the chair with the back and head well supported

- Position the dental chair low for maxillary projections and elevate for mandibular projections.
- Adjust the X-ray unit for proper exposure time. The kVp, and mA are inbuilt with the machine.
- The exposure time is varied depending on the build of the patient and the structures to be imaged.
- Wash the hands with soap and water and put on the disposable gloves.
- Examine the oral cavity assess the shape of the arch, inclination of the teeth. Look for any obstructions like tori or anatomical variations that may require modification in the film packet placement.
- Remove the film from the dispenser and insert it into the film holder (snap-a-ray film holder). Use of finger to hold the film in place is not recommended.
- The smooth, white surface of the film packet must face the X-ray tubehead with the film orientation dot opposite the crown.
- The film packet is positioned depending upon the teeth, which is radiographed. For anteriors the long axis of the film is vertical and for the posteriors the long axis of the film is horizontal.
- Position the film in the region of the patient's mouth that has to be examined.
- Try to avoid contact with the sensitive attached gingiva covering the alveolar process for mandibular anteriors and posterior projections.
- The particular tooth being examined should be in the centre of the film.
- About 2 mm of the film packet should extend beyond the incisal and occlusal edges to ensure that the entire tooth appears on the film.
- The bite blocks of the film holder should rest on the teeth to be radiographed. Ask the patient to close the mouth slowly.
- The correct vertical and horizontal angulations are assessed and the X-ray tube head is positioned accordingly.
- Ask the patient not to move and then expose the film

- Remove the film packet from the patient's mouth, dry it with the paper towel and place it in an appropriate area outside the exposure field.
Film is ready for processing.

Vertical Angulation of the X-ray Tubehead

The vertical angle is the angle formed by extending the path of the central ray until it meets the occlusal plane. This determines the vertical angulation of the X-ray beam to the occlusal plane.

Placement and Angulation of Position Indicating Device for Bisecting Angle Technique

Maxillary Teeth

<i>Tooth</i>	<i>Vertical Angulation (degrees)</i>	<i>Placement of position indicating device</i>
Incisors	+ 45	Tip of nose
Canine	+ 50	Ala of nose
Premolars	+ 40	Mid pupillary line
Molars	+ 30	Outer canthus of the eye

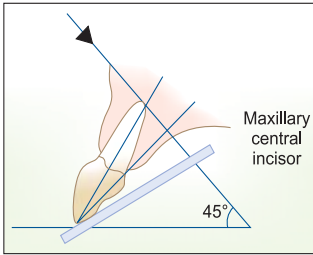
Mandibular Teeth

<i>Tooth</i>	<i>Vertical Angulation (degrees)</i>	<i>Placement of position indicating device</i>
Incisors	– 25	Tip of chin
Canine	– 20	Corner of the mouth
Premolars	– 15	Mid pupillary line
I and II Molars	– 05	Outer canthus of the eye
3rd Molar	0	Angle of mandible

(For maxillary arch projections: Figures 16.8A and B, 16.9A and B, 16.10A and B, 16.11A and B)

(For mandibular arch projections: Figures 16.12A and B, 16.13A and B, 16.14A and B, 16.15A and B)

Vertical angulations recommended are only approximate, hence each positioning should be assessed individually. The vertical angulations largely depend on the patients' head position and inclination of the tooth, so the angulations recommended can be taken as a general guide.

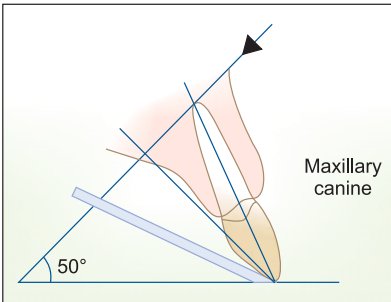


A



B

Figures 16.8A and B: Patient positioning for imaging maxillary central and lateral incisors

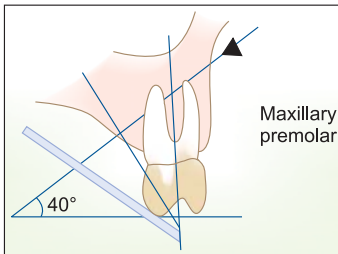


A



B

Figures 16.9A and B: Patient positioning for imaging maxillary canine

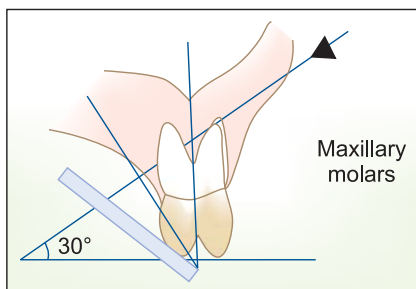


A

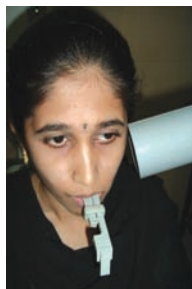


B

Figures 16.10A and B: Patient positioning for imaging maxillary premolar

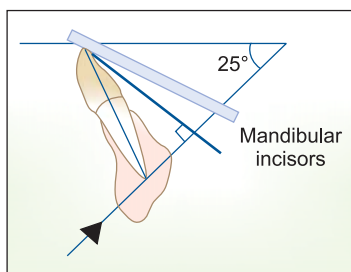


A

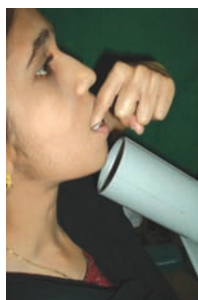


B

Figures 16.11A and B: Patient positioning for imaging maxillary premolar

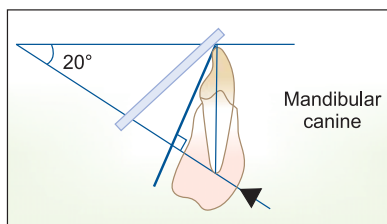


A



B

Figures 16.12A and B: Patient positioning for imaging mandibular central and lateral incisors

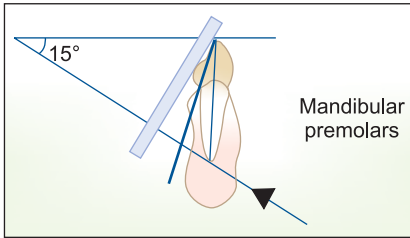


A



B

Figures 16.13A and B: Patient positioning for imaging mandibular canine

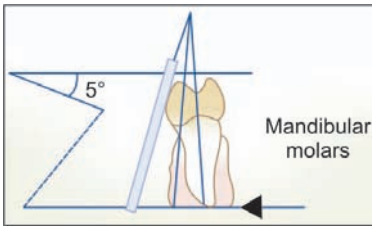


A



B

Figures 16.14A and B: Patient positioning for imaging mandibular premolar



A



B

Figures 16.15A and B: Patient positioning for imaging mandibular molar

Increased vertical angulation causes foreshortening of the image and decreased vertical angulation causes elongation of the image.

Horizontal Angulations of the X-Ray Tubehead

The shape of the arch and the position of the teeth determine the horizontal angulation. In the horizontal plane the central ray should be aimed through the interproximal contact.

Incorrect horizontal angulation results in overlapping of the image.

Advantages of the Bisecting Angle Technique

- Positioning of the film packet is reasonably comfortable for the patient.
- Positioning is relatively easy, simple and quick
- If angulations are assessed properly there will be no changes in the dimensions of the tooth which is imaged.

Disadvantages of the Bisecting Angle Technique

- Multiple variables involved in the technique often results in image distortion
- Incorrect vertical angulation will result in foreshortening or elongation of the image
- The buccal roots of the maxillary premolars and molars are foreshortened
- Incorrect horizontal angulation will result in overlapping of the images.
- The crowns of the teeth are often distorted and hence detection of proximal caries will be difficult.
- The periodontal bone levels are poorly represented.
- The shadow of the zygomatic bone frequently overlaps the periapical areas of maxillary molars.
- To assess the horizontal and vertical angulation considerable skill is required
- Reproduction of images is not possible.

Paralleling Technique

In this technique the film packet is placed in a holder and positioned in the mouth parallel to the long axis of the tooth to be radiographed.

The central beam from the X-ray tube head is aimed at right angles to the tooth and film packet. This technique is superior to bisecting angle technique as the images obtained have minimal geometric distortion (Figure 16.16).

Film packet holders (E.g. Rinn XCP holder) (Figure 16.17) have been developed for this technique. The film packet holders have three basic components:

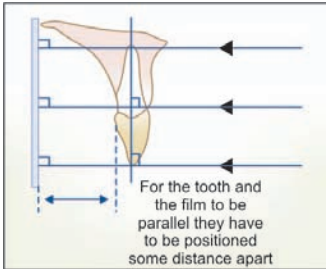


Figure 16.16: Paralleling technique



Figure 16.17: Photograph showing Rinn XCP film holder

- A mechanism for holding the film packet parallel to the teeth that also prevents bending of the film
- A bite block or a platform
- An X-ray beam-aiming device. This may or may not provide additional collimation of the beam.

Positioning

The general guidelines remain the same for this technique, however the following modifications have to be followed:

- The appropriate holder and size of film packet are selected. For anteriors an anterior holder, a small film packet with its long axis vertical to the tooth is used. For posteriors use a posterior holder and a large film packet with its long axis horizontal.
- The smooth, white surface of the film packet must face towards the X-ray tube head.
- The end of the film packet with the embossed orientation dot is placed opposite the crowns of the teeth (to avoid subsequent superimposition of the dot over the apex)
- The following guidelines can be used to place the holder and film packet in the mouth
 - a. For maxillary anteriors the film packet is positioned sufficiently posteriorly, to enable its height to be accommodated in the palatal vault.

- b. For mandibular anteriors the film packet is positioned in the floor of the mouth, roughly in line with the lower canines or first premolar
- c. For maxillary premolars and molars the film packet is placed to accommodate its height in the vault of the palate.
- d. For mandibular premolars and molars the film packet is placed in the lingual sulcus next to the appropriate teeth.
- The holder is rotated so that the teeth under the investigation are touching the bite block
- A cotton wool is placed on the reverse of the bite block, this often helps to keep the tooth and film packet parallel and may make the holder less uncomfortable
- The patient is asked to bite gently, to stabilize the holder
- The locator ring is moved down the indicator rod until it is in contact with the patient's face. This ensures the correct focal spot to film distance
- The long spacer cone is aligned with the locator ring. This automatically sets the vertical and horizontal angles and centers the X-ray beam on the film packet
- The film is exposed.

Advantages of the Paralleling Technique

- Geometrically accurate images are produced with little magnification
- The horizontal and vertical angulations of the X-ray tube head are automatically determined by the position indicating device
- The X-ray beam is directed at the center of the film. This exposes all the areas of the film and there is no cone cutting
- The relative positions of the film packet, teeth and X-ray beam are always maintained, irrespective of the position of the patient's head. This is useful for some patients with disabilities.
- The crowns of the teeth are well shown which helps in detecting the proximal caries

- The periapical tissues are accurately shown with minimal foreshortening or elongation
- The periodontal bone levels are well determined.
- The shadow of the zygomatic bone appears above the apices of the molar teeth
- Reproducing radiographs are possible at different visits and with different operators.

Disadvantages of the Paralleling Technique

- Positioning of the film packet can be very uncomfortable for the patient, particularly for the posterior teeth as it causes gagging
- Positioning the holders in the lower third molar regions is very difficult
- The anatomy of the mouth sometimes makes the technique impossible in cases of a shallow flat palate
- The apices of the teeth can sometimes appear very near the edge of the film, hence large periapical lesions may not be radiographed.
- The technique cannot be performed satisfactorily using a short focal spot to skin distance because of magnification of the image.
- Positioning of the holders within the mouth can be difficult for inexperienced operators
- The holders need to be autoclaved or disposed.

BITEWING RADIOGRAPHY

In this technique the patient is asked to bite on the bite block provided by the special bitewing film holders. The exposed film is designed to show the crowns of the teeth and the alveolar crestal bone (Figure 16.18).



Figure 16.18: Bitewing radiograph



Indications

- Detection of incipient proximal caries
- Monitoring the progression of dental caries
- Assessment of the periodontal status (assessment of crestal bone height)
- Assessment of the existing restorations (secondary caries detection)

Bitewing radiographs are taken by two different methods

- Using a tab attached to the film packet
- Using a bitewing film holder to position the film packet.

Technique

- The tab or the bite platform should be positioned on the middle of the film packet and parallel to the upper and lower edges of the film packet.
- The patient head is positioned with the head supported and with the occlusal plane horizontal
- The shape of the dental arch is assessed
- If a film holder is used position the film holder and align the tube head
- If a tab is attached to the film packet then the operator holds the film packet between the thumb and forefingers and inserts the film packet into the lingual sulcus of the dental arch.
 - a. The tab is placed on to the occlusal surfaces of the tooth
 - b. The patient is asked to occlude the teeth firmly on the tab
 - c. As the patient closes the teeth, the operator pulls the tab firmly between the teeth to ensure that the film packet and the teeth are in contact
 - d. The operator releases the tab
 - e. The X-ray beam is aimed directly through the contact areas, at right angles to the teeth and the film packet, with an approximate 5 to 8° downward vertical angulation.
 - f. Film is exposed.

The exposure factors should be adjusted according to the requirements. For assessment of dental caries and restorations films should be well exposed and should show good contrast to differentiate between the enamel and dentin. Radiograph should show enamel-dentin junction. While assessing the periodontal status, the film should be underexposed to avoid the burn out of the thin alveolar crest.

A typical full mouth set of radiographs consists of 21 films:

Anterior periapical (use No. 1 film)

- Maxillary central incisor (11 and 21): one projection
- Maxillary lateral incisors (12 and 22): two projections
- Maxillary canines (13 and 23): two projections
- Mandibular centrals and laterals (31,32 and 41,42): two projections
- Mandibular canines (33 and 43): two projections

Posterior periapical (use No.2 film)

- Maxillary premolars (14, 15 and 24, 25): two projections
- Maxillary molars (16, 17, 18 and 26, 27, 28): two projections
- Mandibular premolars (34, 35 and 44, 45): two projections
- Mandibular molars (36, 37, 38 and 46, 47, 48): two projections

Bitewing (use No. 2 film)

- Premolars: two projections
- Molars: two projections

Additional projections

- Maxillary distomolar (if required): two projections
- Mandibular distomolar (if required): two projections

OCCLUSAL RADIOGRAPHY

Occlusal radiography is one of the intraoral techniques. Radiographs are taken using a dental X-ray machine and a film of a size 5.7 cm by 7.6 cm or a small intraoral cassette is placed in the occlusal plane.

The terminology used for categorizing various techniques in occlusal radiography is not standardized. There is still no uniformity in terminology and is very confusing.

Maxillary Occlusal Projections

- Standard occlusal
 - a. Cross sectional maxillary projection
 - b. Anterior maxillary projection
- Lateral maxillary occlusal projection (Oblique occlusal)
- Vertex occlusal

Mandibular Occlusal Projections

- Cross sectional mandibular occlusal projection (lower 90° occlusal)
- Anterior mandibular occlusal projection (lower 45° occlusal)
- Oblique occlusal

Technique and Positioning in Maxillary Projections

(a) Standard occlusal- Cross sectional maxillary projection

This projection shows the anterior part of the palate, zygomatic process of the maxilla, anteroinferior aspect of the antrum, nasolacrimal canals, teeth from second molar to second molar, and nasal septum

Indications

- To detect the presence of unerupted canines, supernumeraries and odontomas
- As the midline view for determining the bucco/palatal position of unerupted canines
- Evaluation of the size and extent of lesions such as cysts or tumors in the anterior maxilla
- Assessment of fractures of the anterior teeth and alveolar bone.
- Periapical assessment of the maxillary anteriors, especially in children and also in adults who are unable to tolerate periapical films.



Figure 16.19: Maxillary standard occlusal

Technique (Figure 16.19)

- Patient is seated with head supported and with the occlusal plane horizontal, and sagittal plane perpendicular to the floor.
- Film is placed with its long dimension perpendicular to the sagittal plane, across the mouth.
- The film packet, with the pebbly surface facing uppermost, is placed flat into the mouth on to the occlusal surfaces of the teeth. Push the film in backward until it contacts the anterior border of the rami. The patient is asked to bite gently.
- The X-ray tubehead is positioned above the patient midline, aiming downwards through the bridge of the nose just below the nasion, at a vertical angle of 65° - 70° to the film packet, and 0° horizontal angulation

(b) Standard occlusal- Anterior maxillary occlusal projection
This projection shows the anterior maxilla and its dentition from canine-to-canine and anterior floor of the nasal fossa.

- Positioning is followed as same as for the cross sectional maxillary projection
- The central ray passes through the tip of the nose towards the midline with an angulation of 45° and 0° horizontal angulation

Lateral Maxillary Occlusal Projection

This projection shows the posterior part of the maxilla, inferolateral aspect of the antrum, tuberosity, and teeth from lateral incisor to the contralateral third molar.

Indications

- Periapical assessment of the maxillary posteriors especially patients with trismus and in patients who cannot tolerate the periapical films.
- Evaluation of the size and extent of lesions such as cysts, tumors or osteodystrophies affecting the posterior maxilla
- Assessment of the antral floor
- As an aid to determine the position of the roots displaced inadvertently onto the antrum during an attempted extraction of maxillary posterior teeth
- To assess fractures of the posterior teeth and associated alveolar bone including the tuberosity.

Technique (Figure 16.20)

- Patients positioning is followed as same as for the maxillary occlusal projections
- The film is placed with its long axis parallel to the sagittal plane and on the side of interest
- Push the film until it touches the ramus
- Position the film's lateral border parallel with the buccal surfaces of the posterior teeth, extending laterally approximately 1 cm past the buccal cusps.



Figure 16.20: Oblique maxillary occlusal

- Ask the patient to close the mouth and to bite on the film gently.
- The X-ray tubehead is positioned to the side of the patients face aiming downwards through the cheek approximately 2 cm below the lateral canthus of the eye. The central ray is passed at a vertical angulation of 65° to 70° to the film.

Vertex Occlusal Projection

This is an additional projection. This projection shows the tooth-bearing portion of the maxilla from above. A high dose of radiation is required, as the X-ray beam has to pass through a considerable amount of tissue. An intraoral cassette with an intensifying screen is used to reduce the dose.

Indication

- To assess the bucco/palatal position of unerupted canines

Technique (Figure 16.21)

- Patient is seated with head supported and with the occlusal plane parallel to the floor
- The cassette is placed inside a small plastic bag to prevent salivary contamination and cross infection
- It is then inserted into the mouth on to the occlusal surfaces of the lower teeth, with its long axis anteroposteriorly and the patient is asked to bite on it.
- The X-ray tube head is positioned above the patient, in the midline, aiming downwards through the vertex of the



Figure 16.21: Vertex maxillary occlusal

skull. The central beam is aimed approximately down the long axis of the root canals of the maxillary incisor teeth.

Disadvantages

- There is lack of detail and contrast on the film because of the intensifying screens
- The X-ray has to pass through the mass of the tissue and hence results in scattering
- Relatively long exposure time
- Radiation effects to the lens of the eye
- Superimposition of the frontal bones obscuring the radiographic image of the anterior part of the maxilla

Cross-Sectional Mandibular Projection (Lower 90° Occlusal)

This projection shows the tooth bearing portion of the mandible and the floor of the mouth, lingual and buccal plates of the mandible from second molar to second molar.

Main clinical indications

- Detection of the presence and position of radiopaque calculi in the submandibular salivary ducts
- Assessment of the bucco-lingual position of unerupted mandibular teeth
- Evaluation of the bucco-lingual expansion of the body of the mandible by cysts, tumours or osteodystrophies
- Assessment of displacement fractures of the anterior body of the mandible in the horizontal plane.

Technique and positioning (Figure 16.22)

1. The film packet, with the white (pebbly) surface facing downwards, is placed centrally into the mouth, on to the occlusal surfaces of the lower teeth, with its long axis crossways. The patient is asked to bite gently.
2. The patient then leans forwards and then bends the head backwards as far as is comfortable, where it is supported.
3. The X-ray tubehead is placed below the patient's chin, in the midline, centering on an imaginary line joining the first molars at an angle of 90° to the film. The central ray is at



Figure 16.22: Cross-sectional mandibular occlusal projection

the midline approximately 3 cm below the chin, at right angles to the center of the film.

4. When the view is made to examine the floor of the mouth (e.g. sialoliths), the exposure time should be reduced to one half the time to produce the image of the mandible.

Variation of technique: This projection covers the soft tissue of half the floor of the mouth, buccal and lingual cortical plates of half of the mandible, and teeth from the lateral incisor to the contralateral third molar.

To show one half of the mandible, the film packet is placed in the mouth with its long axis anteroposteriorly on the side of interest. The X-ray tubehead, still aimed at 90° to the film, is centered below the body of the mandible on that side.

Note: The lower 90° occlusal is mounted as if the examiner were looking into the patient's mouth. The radiograph is therefore mounted with the embossed dot pointing away from the examiner.

Anterior Mandibular Occlusal Projection (Lower 45° Occlusal)

This projection shows the lower anterior teeth and the anterior part of the mandible, dentition from canine to canine, and inferior border of the mandible.

Technique and positioning (Figure 16.23)

1. The patient is seated with the head supported and with the occlusal plane horizontal and parallel to the floor.



Figure 16.23: Anterior mandibular occlusal projection

2. The film packet, with the white (pebbly) surface facing downwards, is placed centrally into the mouth, on to the occlusal surfaces of the lower teeth, with its long axis anteroposteriorly, and the patient is asked to bite gently.
3. The X-ray tubehead is positioned in the midline, centering through the chin, at an angle of 45° to the film.

Lower Oblique Occlusal

This projection is designed to allow the image of the submandibular salivary gland, on the side of interest, to be projected on to the film. However, because the X-ray beam is oblique, all the anatomical tissues shown are distorted.

Main Indications

The main clinical indications include:

- Detection of radiopaque calculi in a submandibular salivary gland/duct
- Assessment of the bucco-lingual position of unerupted lower third molars
- Evaluation of the extent and expansion of cysts, tumours or osteodystrophies in the posterior part of the body and angle of the mandible.



Figure 16.24: Oblique mandibular occlusal projection

Technique and Positioning (Figure 16.24)

The technique can be summarized as follows

1. The film packet, with the white (pebbly) surface facing downwards, is inserted into the mouth on to the occlusal surfaces of the lower teeth, over to the side under investigation, with its long axis anteroposteriorly. The patient is asked to bite gently.
2. The patient's head is supported and then turned away from the side under investigation and the chin is raised. This rotated positioning allows the subsequent positioning of the X-ray tube head
3. The X-ray tubehead is aimed upwards and forwards towards the film, from below and behind the angle of the mandible and parallel to the lingual surface of the mandible

Note: The lower oblique occlusal is also mounted with the embossed dot pointing away from the examiner.

VARIATIONS IN PERIAPICAL RADIOGRAPHY

Placement of Films intraorally in ideal position is always difficult. To overcome these difficulties radiographic techniques need to be modified. The main difficulties encountered involve:

- Mandibular third molars projections
- Endodontic imaging
- Edentulous alveolar ridges
- Gagging

Difficulties in Third Molar Projections

When the third molar is horizontally impacted it is difficult to record the entire third molar and the surrounding structures. To overcome this difficulty the following procedure need to be followed:

- Use the surgical needle holder to hold and position the film
- The needle holder is clipped firmly on to the top edge of the film
- The patient is asked to close the mouth on to the handle of the holder and at the same time the film packet is eased further back into the mouth until its front edge is opposite the mesial surface of mandibular first molar.
- Patient is asked to support the handles of the needle holder in position.
- The X-ray tubehead is positioned posteriorly aiming forwards to project the apex of the third molar on the film. The X-ray beam passes from the distal aspect of the tooth to mesial aspect. It should be noted that with this variation the crowns of the second and the third molar will overlap (Figure 16.25).

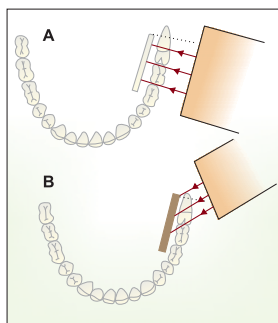
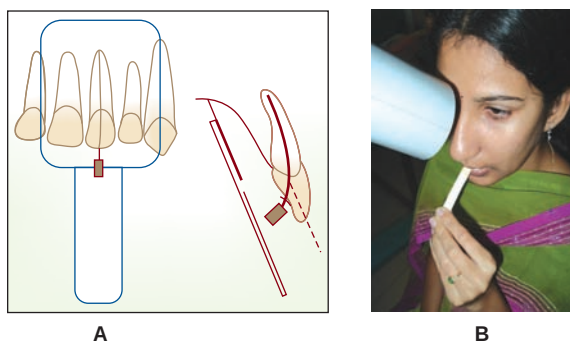


Figure 16.25: Variation in technique for 3rd molar projection

Endodontics

In endodontics the problem encountered is during the placement of the film along with endodontic instrument and its stabilization. To overcome this problem a wooden spatula or ice cream stick can be used especially when anterior teeth are radiographed. The intraoral film packet is taped to one end of the wooden spatula and is positioned in the mouth. The patient is then asked to it in place (Figure 16.26).



Figures 16.26A and B: Variation in technique for endodontics

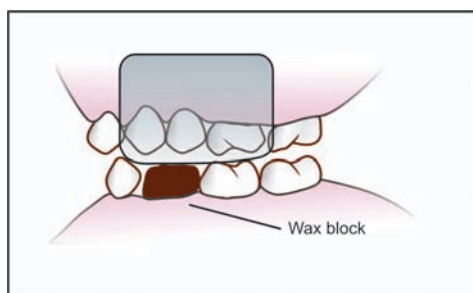


Figure 16.27: Variation in technique for edentulous arches

Edentulous Ridges

Film packet placement will be difficult in partially edentulous patient. Cotton rolls or a block of wax can be placed over the edentulous site to support the film packet during exposure (Figure 16.27).

Gagging

The gag reflex makes placement of the film packet difficult in ideal position in the mouth. It is particularly difficult in maxillary and mandibular posteriors. To overcome these difficulties the following procedures are recommended:

- Patient is asked to suck a local anesthetic lozenge before the film is placed, or a local anesthetic agent is applied topically.
- By asking the patient to concentrate on breathing deeply
- Placing the film flat in the mouth (like occlusal projection) and increasing the vertical angulations. However, there will be distortion of surrounding structures.

Extraoral Radiography

Extraoral radiographs play an important part in examination of the orofacial region. It is used to examine the skull and facial structures and to evaluate the skeletal growth. However the complexity of the structure of the maxillofacial skeleton, temporomandibular joint, and base of the skull requires many different projections.

Lateral Cephalometric Projection (Lateral Skull Projection)

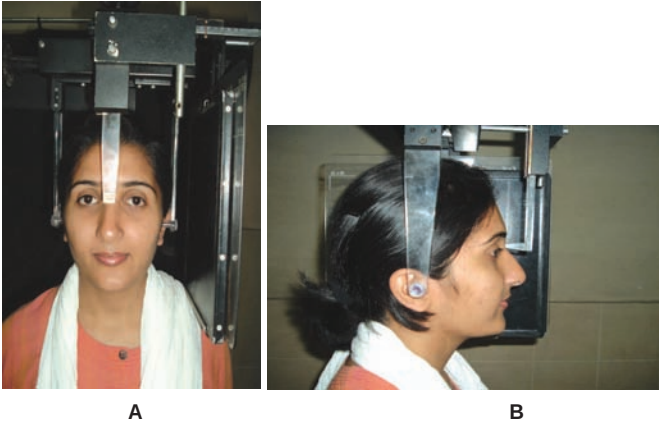
The lateral cephalometric projection reveals the facial soft tissue profile but otherwise it is same as the lateral skull projection.

Indications

- To assess the facial growth
- To survey the skull and the facial bones for evidence of trauma, developmental abnormality and disease
- To examine the nasopharyngeal soft tissue, paranasal sinuses and hard palate
- For pretreatment and post treatment records in orthodontics.

Technique (Figures 16.28 A and B)

- The cassette is positioned vertically or horizontally in a cassette-holding device
- The head is positioned with the left side of the face near the cassette
- The midsagittal plane parallel with the plane of the film
- A wedge filter is placed on the anterior side of the beam at the tube head. This absorbs the radiation and prevents



Figures 16.28A and B: Photograph showing patient positioning for lateral cephalogram

it from striking the nose, lips, chin and thus helps in revealing the soft tissue outline of the patient's face on the radiograph

- The central ray is directed towards the external auditory meatus, perpendicular to the plane of the film and the midsagittal plane.
- The distance between the X-ray source and the midsagittal plane for cephalometric projections is 152.4 cm (60 inches)
- Exposures recommended for films with intensifying screens are 70 kVp, 15 to 25 mAs. However the exposure parameters may vary according to type of X-ray machine

Posteroanterior (PA view) Projection of the Skull

This projection shows the skull vault, primarily the frontal bones and the jaws. Here the X-ray beam passes in a posterior to anterior direction through the skull.

Indications

- To examine the skull for diseases, trauma or developmental abnormalities

- To assess the asymmetry in mediolateral dimensions
- To assess the facial structures, frontal and ethmoid sinuses, nasal fossae, and orbits.

Technique (Figure 16.29)

- The cassette is positioned vertically in a cassette holding device
- For the straight posteroanterior projection the head is centered in front of the cassette with canthomeatal line parallel to the floor

For cephalometric applications the nose

should be a little higher so that the anterior projection of the canthomeatal line is 10° above the horizontal plane and the Frankfort plane is perpendicular to the film. This helps the superior border of the petrous ridge to lie on the lower third of the orbit.

- The source should be coinciding with the midsagittal plane of the head at the level of the bridge of the nose.
- The central ray is directed perpendicular to the plane of the film
- The source is at a distance of 91 to 102 cm (36 to 40 inches)
- Exposures recommended for films with intensifying screens are 70 kVp, 30 to 50 mAs. However the exposure parameters may vary according to type of X-ray machine.



Figure 16.29: Photograph showing patient positioning for PA projection of skull

Water's Projection (Occipitomental Projection), Paranasal Sinus View (PSV)

It is a variation of the posteroanterior projection. It shows the facial skeleton and the maxillary antrum, and avoids the superimposition of the dense bones of the base of the skull.

Indications

- To evaluate the maxillary sinuses
- Frontal, ethmoidal sinuses, orbit, the zygomaticofrontal suture and nasal cavities are also visualised
- Position of the coronoid process between the maxilla and the zygomatic arch can also be seen.

Technique (Figure 16.30)

- The cassette is positioned vertically
- The head is oriented in such a way that the sagittal plane is perpendicular to the plane of the film
- The chin is raised high to elevate the canthomeatal to 37° above the horizontal plane.
- To avoid the superimposition of the petrous portion of the temporal bone over the maxillary sinus the chin has to be elevated further.
- To investigate the sphenoid sinus the projection needs to be taken with patient's mouth open
- The central ray should be perpendicular to the film, through the midsagittal plane, and at the level of the maxillary sinus.
- Exposures recommended for films with intensifying screens are 70 kVp, 100 mAs. However the exposure parameters may vary according to type of X-ray machine, and the distance from the source to the patient.



Figure 16.30: Photograph showing patient positioning for Water's projection

Reverse-Towne's Projection

This projection shows the condylar heads and necks. In dentistry all skull views are taken conventionally in a posteroanterior direction. The Reverse Towne's is also taken in a posteroanterior direction.

Indications

- To examine the fractures of the condylar neck
- It also shows the medially displaced condyle
- This projection also reveals the posterolateral wall of the maxillary sinus.

Technique (Figure 16.31)

- The cassette is positioned in a holding device
- The head is centered in front of the cassette with the canthomeatal line oriented 25 to 30 degrees downward
- The central ray is directed toward the film in the sagittal plane through the occipital bone
- For better visualization of the condyles patient is asked to open his mouth as wide as possible.
- Exposures recommended for films with intensifying screens are 70 kVp, 100 mAs. However the exposure parameters may vary according to type of X-ray machine



Figure 16.31: Photograph showing patient positioning for Reverse Towne's

Submentovertex View

This projection shows the base of the skull, sphenoidal sinuses and the facial skeleton from below.

Indications

- It demonstrates the base of the skull
- To examine the displacement of the fractured zygomatic arch
- To evaluate the position and orientation of the condyles
- To examine the sphenoid sinuses and the lateral wall of the maxillary sinuses

- To assess the curvature of the mandible
- It also shows the medial and lateral pterygoid plates and foramina at the base of the skull.

Technique (Figure 16.32)

- The film cassette is placed vertically in a holding device
- The patient's head and neck should be extended backward as far as possible, with the vertex of the skull on the center of the cassette. It is helpful to lean the patient's chair back as far as possible as it will go to help the patient orient the head
- Midsagittal plane of the head should remain perpendicular to the floor
- The canthomeatal line should extend 10 degree past vertical so that the Frankfurt line is vertical and parallel to the film
- The central ray is directed from below the mandible upward, towards the vertex of the skull. It should pass 2 cms in front of a line connecting the right and left condylar processes
- Exposures recommended for films with intensifying screens are 70 kVp, 100 mAs. However the exposure parameters may vary according to type of X-ray machine, grids and distance from the source to the patient. To view the zygomatic arches specifically, the exposure time should be reduced to one third that is used for visualizing the skull. This view is referred to as jug-handle view.

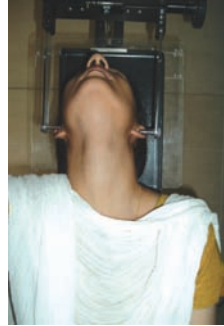


Figure 16.32: Photograph showing patient positioning for Submentovertex

Lateral Oblique Projections

Lateral oblique projections are used to examine the mandible. It covers larger areas than the intraoral radiographs. However, panoramic radiographs replace these projections. Lateral oblique can be recommended when an image of greater resolution is required.

There are two projections:

1. Mandibular body projection
2. Mandibular ramus projection

Mandibular Body Projection

Indications

- Demonstrates the pre-molar region
- Inferior border of the mandible can also be viewed

Technique (Figure 16.33)

- The dental X-ray machine with an open ended cylinder is best used
- Screen film of 5 by 7 inches (13 by 18 cm) or larger is used
- The cassette is placed against the patient's cheek and is centered over the first molar
- The cassette's lower border is parallel to the inferior border of the mandible and it extends at least 2 cm below it.
- Patient is asked to hold the cassette in place
- The head is tilted toward the side being examined
- Mandible is protruded.
- The central ray is directed toward the first molar region of the mandible from a point 2 cm below the angle of the tube side.
- The central ray should be as close to perpendicular to the plane of the film as possible
- The exposure time is around 1 second

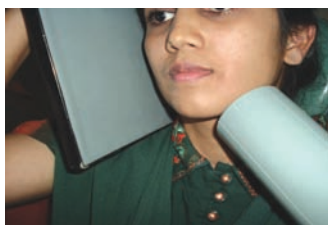


Figure 16.33: Photograph showing patient positioning for Lateral oblique (mandibular body)

Mandibular Ramus Projection

Indications

- It is used for examining the third molar regions of maxilla and mandible

- To view the ramus from angle of the mandible to the condyle

Technique (Figure 16.34)

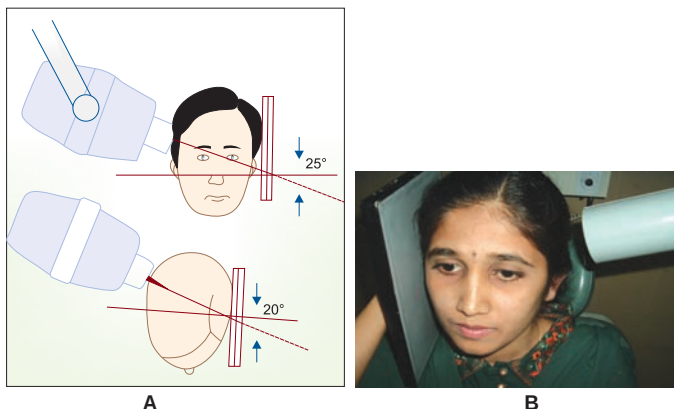
- The dental X-ray machine with an open ended is best used
- Screen film of 5 by 7 inches (13 by 18 cm) or larger is used
- The cassette is placed over the ramus and far enough posteriorly to include the condyle
- The lower border of the cassette should be approximately parallel with the inferior border of the mandible and should extend at least 2 cm below the border.
- Head is tilted towards the side of the mandible being examined until a line between the mandibular angle next to the tube and the condyle away from the tube is parallel with the floor.
- Patient is asked to protrude the mandible to avoid the cervical spine to be superimposed on to the ramus.
- The central ray is directed posteriorly towards the center of the ramus on the side of interest from a point 2 cm below the inferior border of the first molar region of the mandible on the tube side
- The exposure time is around 1 second.



Figure 16.34: Photograph showing patient positioning for Lateral oblique (mandibular ramus)

Temporomandibular Imaging

Temporomandibular imaging depends on the clinical problem and the involvement of the hard or the soft tissues. The hard tissue imaging includes panoramic projections, transcranial, transpharyngeal, trans orbital, submentovertex projection and conventional tomography. Soft tissue imaging techniques include arthrography and magnetic resonance imaging.



Figures 16.35A and B: Transcranial projection for TMJ

Transcranial Projection

It provides a sagittal view of the lateral aspects of the condyle and temporal component

Technique (Figure 16.35 A and B)

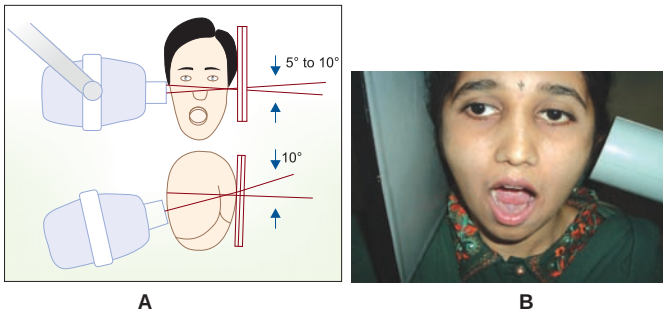
- TMJ under investigation is touching the film and the sagittal plane of the head is parallel to the film
- The X-ray tube head is positioned with the central ray aimed downwards at 25° to the horizontal, across the cranium, centering through the TMJ of interest.

Diagnostic information

- The size of the joint spaces
- The position of the condyle within the fossa
- The shape of the glenoid fossa and the articular eminence (lateral aspect only)
- The shape and head of the condyle and the condition of the articular surface (Lateral aspect only)

Transpharyngeal (Parma Projection)

It provides a sagittal view of the medial pole of the condyle



Figures 16.36A and B: Transpharyngeal projection for TMJ

Technique (Figures 16.36 A and B)

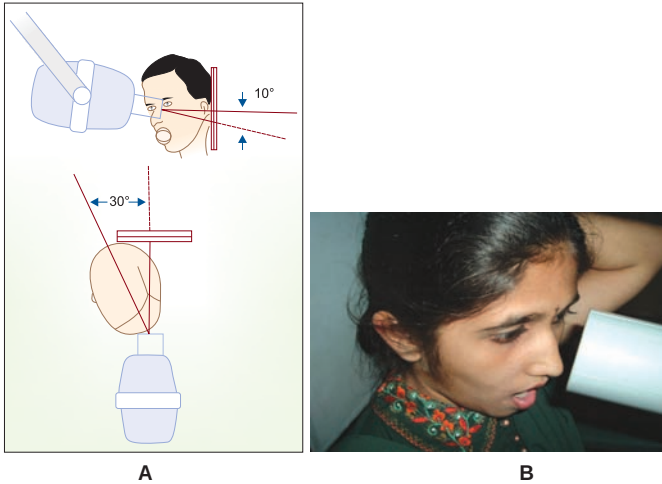
- Patient holds the cassette against the side of the face over the TMJ of interest.
- The film and the sagittal plane of the head are parallel
- Patient's mouth is open
- The X-ray tubehead is positioned in front of the opposite condyle and beneath the zygomatic arch
- It is aimed through the sigmoid notch, slightly posterior, across the pharynx at the condyle under investigation,
- The X-ray beam is directed superiorly at -5 degrees through the sigmoid notch of the opposite side and 7 to 8 degrees from the anterior.

Transorbital Projection (Zimmer's projection)

It provides anterior view of TMJ—anteroposterior view of the condylar head.

Technique (Figures 16.37 A and B)

- The patient holds the cassette behind the ear, behind the TMJ of interest
- Patient's mouth is kept open
- The X-ray tubehead is positioned near the inner canthus of the eye (ipsilateral) and aimed backwards at the condyle under investigation
- Patient's head is tilted at 10° so that the canthomeatal line is horizontal



Figures 16.37A and B: Transorbital projection for TMJ

Diagnostic information

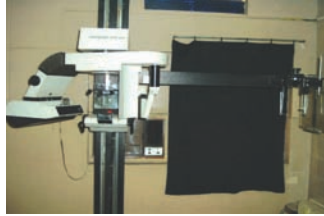
- The shape of the condylar head and neck from the anterior aspect
- The condition of the articular surface from the anterior aspect.

PANORAMIC RADIOGRAPHY

Panoramic radiography or also known as pantomography is a technique where in a single image is produced of the facial structures, maxillary and mandibular arches and their supporting structures. It is usually used as an initial survey radiograph and it assists in determining the need for other projections. It is indicated in evaluation of trauma, third molars impaction, orthodontic assessment, fractures, TMJ disorders, periodontal diseases, and extensive or suspected large bone lesions, assessment of tooth eruption, edentulous patients, in inserting osseo-integrated implants and developmental anomalies (Figure 16.38).



A



B



C

Figures 16.38A to C: Photographs showing types of OPG machines

Advantages

- Broad coverage of the facial bones and teeth
- Low patient radiation dose
- Used in patients with trismus
- Relatively short time to make a panoramic image
- Readily understood by patients (patient education)
- Useful visual aid in case presentations.

Disadvantages

- Does not display fine anatomic details
- Proximal surfaces of premolars often overlap
- Uneven magnification and distortion



Figure 16.39: Photograph showing patient positioning for OPG

- Cervical spine overlap on the incisor regions limiting the identification of the abnormalities in the midline
- Objects out of the plane of focus may get distorted or not imaged at all.

Patient Positioning (Figure 16.39)

- Remove all dental appliances, earrings, hairpins, necklaces, and any other metallic objects in the head and neck region
- Demonstrate the machine movement and instruct the patient to remain still during the procedure
- Instruct the patient to look straight and not to follow the tube head with his/her eyes
- Ask the patient to bite on the bite block
- The midsagittal plane must be centered within the focal trough
- Patients chin and the occlusal plane must be properly positioned to avoid distortion
- The line from the tragus of the ear to the outer canthus of the eye should be parallel with the floor
- Patient's back and spine must be erected and neck should be extended
- Ask the patient to swallow and hold the tongue on the roof of the mouth
- Expose the film.

LOCALISATION TECHNIQUES

Intraoral radiographs apart from the occlusal radiograph do not give a three dimensional view of an object. An intraoral periapical radiograph only reveals the superoinferior and the anteroposterior relationship of a tooth. However, the third dimension, namely the labio lingual relationship can be imaged using variations to the regular projection. These projections are referred to as localization techniques.

Localization techniques do not require an elaborate set up. These techniques are used to assess the mediolateral dimensions and relationships of impacted teeth, foreign objects like broken teeth, remnants of root stumps, and the relationship of the mandibular canal to the apices of third molars.

Commonly used localization techniques are:

1. Miller's technique, Winters technique or Right angle technique
2. Clark's technique, Tube shift technique and SLOB technique
3. Buccal object rule

However other techniques employed can be:

1. Contrast radiography
2. Stereoradiography

Miller's Technique

This technique is particularly useful to assess the mediolateral relationship of an impacted mandibular third molar. This technique cannot be used to localize objects in the maxilla as the X-ray beam should travel through multiple skeletal structures such as the anterior portion of the skull and the bones of the maxilla and the nose. This might result in superimposition of multiple structures in the resultant radiograph. However a variation of the technique can be attempted to view the maxillary 3rd molars.

Technique for Mandibular Third Molars (Figure 16.40)

1. One intraoral periapical radiograph (size 2) is taken for the third molar using the conventional horizontal and vertical angulations
2. A second intra oral film (size 2) is placed over the occlusal plane on the side of interest. The X-ray beam is projected perpendicular to the film.

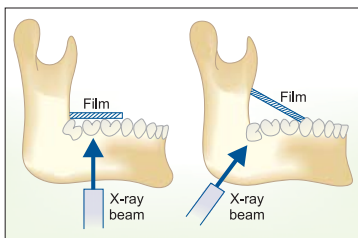


Figure 16.40: Miller's localization technique for mandibular 3rd molars

Variation in the Technique

In some instances the film that should be placed on the occlusal surfaces cannot be placed posterior enough to image the entire third molar (horizontally impacted), as the anterior border of the ascending ramus interferes with the placement of the film in the desired position.

In such instances, the film can be placed in a slanting manner with the posterior border of the film resting on the ascending ramus. Patient is instructed to stabilize the film with his finger. The X-ray is directed perpendicular to the film from the angle of the mandible. In order to facilitate placement of the position-indicating device of the X-ray machine behind the ramus, the patient can be asked to turn his head away from the side being imaged.

Technique for Maxillary Third Molars (Figure 16.41)

The tube shift technique is advocated for localization procedures involving the maxillary 3rd molars. However, a modification in the Miller's technique can be used to localize the position of maxillary 3rd molars.

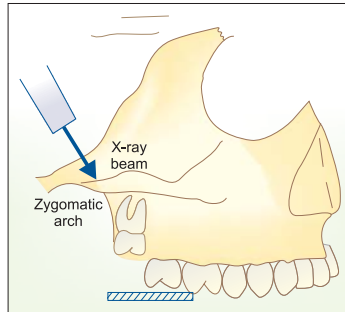


Figure 16.41: Miller's localization technique for maxillary 3rd molar

A size 2 intraoral radiograph is placed over the occlusal surfaces of the maxillary posterior teeth. It should be ensured that the exposure side of the film faces the occlusal surfaces of the upper teeth. The PID is positioned such that the central ray passes through the zygomatic arch towards the film.

The radiographic image obtained will reveal a distorted image due to the oblique direction of the X-rays. However, once the zygomatic arch is identified and then the lateral border of the arch, the buccopalatal position of the maxillary third molar relative to the position of erupted upper teeth can be assessed.

Buccal Object Rule

This technique is used to evaluate the relative relationship of the root apices of the mandibular molars to the mandibular canal. Richards proposed this technique in 1952.

The buccal object rule states “the buccal object will move with a change in angulation of the PID (right or left, up or down).

Technique: (Figure 16.42)

1. A conventional intra oral periapical radiograph of the mandibular 3rd molar is taken
2. A second radiograph is then taken with a -20° vertical angulation.

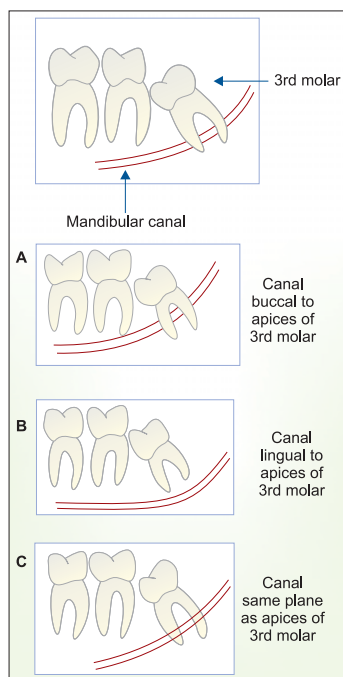


Figure 16.42: Buccal object rule

Both the radiographs are examined. If the mandibular canal in the second radiograph moves in a direction superior to the apices of the mandibular molar, then the mandibular canal is said to be placed buccally in relation to the apices of the mandibular 3rd molar.

If the canal appears to have moved in a direction inferior to the apices of the 3rd molar the mandibular canal is said to be placed lingually to the apices of the 3rd molar.

However, if the canal in the 2nd radiograph does not seem to move as compared to the first radiograph then the canal is assumed to be in the same plane as that of the apices of the 3rd molar.

Tube Shift Technique

This technique is also referred to as Clark's technique.

This technique can be used to localize objects both in the maxilla and the mandible.

Used very effectively to localize the position of impacted teeth (canine, premolars), used to differentiate the mental foramen from periapical lesions involving the premolars.

Principle

If two objects lie in an absolutely straight line with an observer, the more distant object is hidden from view by the object in front. If the observer moves towards the right side the more distant object appears to move to the right and the object closest to the observer appears to move in the opposite direction.

Procedure (Figure 16.43)

In order to make the procedure reproducible, the patient's head can be stabilized by instructing the patient to rest his head on the headrest, ensuring that the sagittal plane is perpendicular to the floor and the occlusal plane is parallel to the floor.

A conventional intraoral radiographic image of the area of interest is taken. A second intraoral radiograph is taken by shifting the PID either mesially or distally (left or right) by a couple of centimeters.

Both the radiographs are examined for any apparent shift of the object in question. This apparent shift of the

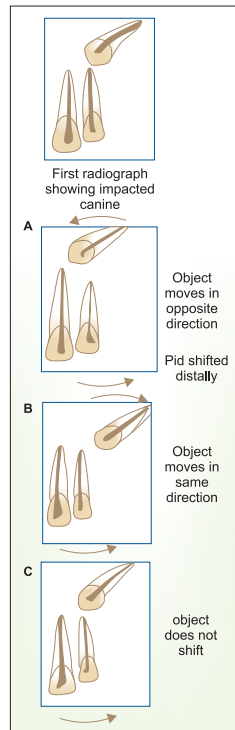


Figure 16.43: Clark's technique

object relative to the original radiograph can be assessed using the SLOB rule. *SLOB is an eponym for Same Lingual Opposite Buccal*. If the object seems to have moved in the same direction as the movement in the PID (i.e. if the PID was moved to the right side then the object also appears to have moved to the right side) in the second radiograph, then applying the SLOB rule it can be concluded that the object is placed lingually to the reference object. If the object seems to have moved in the opposite direction as the movement in the PID (i.e., if the PID was moved to the right side then the object appears to have moved to the left side) in the second radiograph, then applying the SLOB rule it can be concluded that the object is placed buccally to the reference object.

If the object in question does not move with respect to the reference object when the PID is moved, then the object lies in the same vertical plane as the reference object.

Location of Residual Roots in Edentulous Areas

A regular IOPA size 2 (adult) radiograph can be placed in the mouth in the area of interest. Before the film is exposed, an indelible pencil is used to make a mark on the center of the edentulous ridge at the anterior border of the film.

The film is then processed. The distance of the root tip from the anterior border of the film is measured in millimeters using a scale. The same measurement can be measured in the mouth posterior to the pencil mark previously made. This distance gives the exact anteroposterior position of the root stump.

In order to assess the bucco lingual position of the root piece, an occlusal radiograph may be taken. In this process the root stump within the alveolar ridge can be localized. This technique facilitates easily removal of the root stump.

Alternate Technique

Stainless steel wires of uniform thickness are placed at equal distances from one another in a sheet of wax and molded over the edentulous region (resembling a denture base). Once the

wax is adapted to the edentulous ridge a standard intra oral peri apical radiograph is taken. Once the radiograph is processed the location of the root piece in relation to the wires can be assessed.

STEREORADIOGRAPHY

Stereoradiographic procedure was first recognized in 1896. This technique is valuable diagnostic tool as it adds perspective or depth to the radiograph.

Two types of film holders are available to hold the films in an accurate reproducible position for two exposures. One for the intra oral peri apical film and other for the occlusal radiograph. The occlusal film holder is designed in such a way that the film can slide in and out without coming in contact with teeth. It has linear grooves on both the sides and at the back into which the film fits. The film holder is placed in the mouth in the bite position and the occlusal surfaces of teeth coming in contact with the top of the grooves and thus retaining the film in the mouth in a fixed position. Any number of films can now be placed consecutively in the mouth in an accurate and reproducible position.

A small strip of modeling wax is placed over the occlusal aspect of the metal film holder in order to hold the small film. The film is then positioned in the holder. Heating softens the modeling wax and then the holder is placed within the mouth. The softened wax comes in contact with the teeth when the patient bites; this leaves the indentation of the occlusal surfaces of teeth over the softened wax. The metal film holder will prevent the film holder from bending. Therefore the succeeding film can be positioned in the same plane as the first film.

The first exposure is made and the film holder along with the film is withdrawn. A second film is then introduced into the film holder which is then placed in the mouth in exactly the same position as for the first exposure (this is facilitated by the impression of the occlusal surfaces of teeth that were previously recorded). This position is confirmed by the slipping of teeth into the indentations made in the softened compound during the first exposure.



Procedure

The patient's head is immobilized using a strip of gauze piece, which passes around the patient's forehead, and extending backwards around the headrest of the chair and clamping it with a hemostat.

The PID is first centered over the part to be imaged and then shifted 1.5 inches towards the right and then tilted in such a manner that the central beam will pass through the same point of entry they would pass if the PID were centered. The exposure is now made. The PID is then moved back to the center, it is then shifted 1.5 inches towards the left, where a similar procedure is followed as that was followed on the right side.

It will be observed that the PID has moved a total distance of 2.5 inches from left to right, which corresponds to the interpupillary distance in a normal individual. The horizontal angulation of the X-rays will be 7.5 degrees towards the point of entry.

The two films thus imaged are processed in the dark room simultaneously so that the density of both the films are identical. The processed and dried films are mounted in the stereoscope in a manner such that both the images will blend into one. One should ensure that the films are correctly mounted in the stereoscope that is the right side exposure should be placed on the right side and the left side exposure of the left side. The films thus mounted will give a depth perception and help in localization of objects.

Image receptors or films that have been exposed to X-ray radiation are processed either manually or using automatic processors. Manual processing of x-ray films are done in a Dark Room. Like the name suggests this room is specially designed to keep away visible light, as the x-rays are sensitive to visible light.

An ideal dark room has a conch shell design. The dark room can either have a door, or have a doorless maze (Figure 17.1). If the door is present it should be light tight. The door less maze design is preferred. In the event of having a door, it should be totally light tight, should have provisions for locking the door in order to prevent accidental opening of the door, which might unnecessarily expose the image receptors to visible light.



The dark room should be large enough to accommodate at least one radiation personnel and provide enough room to work comfortably. The room should at least be 4 feet by 5 feet in dimension.

Dark Room Equipment

The dark room should contain the following infrastructure

1. Processing tanks
2. Safe lights
3. Visible light source (tube lights)
4. Working area (to load extraoral cassettes)
5. Dryer
6. Thermometer and stop clock
7. Storage facility (to store unexposed films)
8. Exhaust and appropriate ventilation
9. Drying racks

Processing Tanks (Figure 17.2)

The processing tanks must be conveniently placed. They should be placed at a convenient height and away from the working area. The processing tanks are comprised of one master tank and two removable metallic inserts which are placed within the master tank.

Generally a master tank size of 8 by 10 inches should be ideal for a dental office. The two metal containers (inserts), which can be placed in the master tank should be able to hold about nine liters of the fixer and developer solution. The master tank will hold running water maintained at an appropriate temperature, which will in turn regulate the temperature of the developer and fixer. The water contained in the master tank is also used for rinsing the film during processing (Figure 17.3).

Ideally the processing tanks should be made of stainless steel as it does not react with the processing solutions and is easier to maintain. The processing tanks should also have a lid cover to minimize the oxidation of the processing solutions by atmospheric oxygen and evaporation.



Figure 17.2: Photograph showing processing tanks

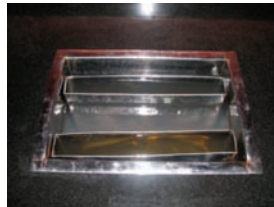


Figure 17.3: Two metal inserts within master tank filled with water

Thermometer and Stop Clock

The thermometer is useful to gauge the temperature of the processing solutions at the commencement of the processing of the film. Based on the temperature of the solutions it can be decided as to how long the film can be placed in the developer and fixer solutions. The thermometer should be ideally clipped on the master tank. Mercury containing thermometers are best avoided as any breakage of the thermometer can lead to contamination of the solutions. An alcohol containing thermometer is best employed.

The stop clock helps the personnel to exactly set the time for the developing and fixing procedure based on the temperature of the processing solutions.

Safe Light and Visible Light Illumination

There should be one safe light over the processing tanks and one over the working area (where the films are loaded) the safe lights should be 4 feet above the working area and processing tanks (Figure 17.4). It should be in the orange-red-yellow spectrum of light. These colors have the longest wavelengths in the spectrum and therefore have a low penetrating power. X-rays are highly sensitive to colors that have the short wavelength such as blue and green.

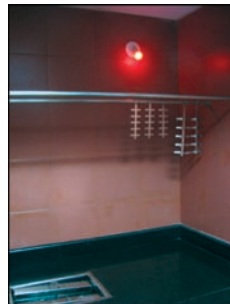


Figure 17.4: Photograph showing ideal position of safe light

Short wavelength $\xrightarrow{\text{V I B G Y O R}}$ Long wavelength

The safe light used in the dark room should be a 15-watt bulb. A red GBX-2 filter is recommended.

Visible light illumination can be in the form of ceiling or wall mounted tube lights. However care should be taken to ensure that these tube lights are switched off during loading the films into cassettes or during processing the films.

Penny Test

A radiographic film is sensitive to visible light and x-rays. Excessive exposure to safe light or an improper safe light condition can lead to exposure of the film resulting in film fog. Such films appear dark and have a muddy gray appearance. The safe lighting conditions in the dark room can be evaluated using a coin test, which is popularly referred to as the "penny test"

Procedure (Figure 17.5)

1. Open the packet of an exposed film and place the film in the area where the films are usually unwrapped and clipped on the film hanger.
2. Place a coin on the film and leave it in this position for about 5 minutes.
3. Develop the film as usual.

If the image of the coin is visible on the resultant film, the room is not light safe.

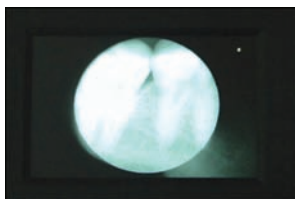


Figure 17.5: Photograph demonstrating penny test

Film Hangers and Drying Racks

Film hangers have to be thoroughly washed and dried before using them. Presence of fixer solution remaining on the hangers may result in faulty radiographs in the form of *light spots*. Water droplets on the hangers may produce watermarks on the films, which might obscure diagnostic details in the radiographic image.

Used film hangers should be hung over drying racks with the facility of drip trays underneath which drain away the water dripping from the hangers.

Dryer or Electric Fan

Wall mounted electric fans placed over the drying racks will help in drying the wet films. A more efficient method of drying wet films is by using cabinet dryers. These dryers circulate warm air around the films thereby accelerating the process of drying films. However it must be ensured that the films are not kept very close to the heat source as the films tend to get distorted. These cabinet dryers can also be located outside the dark room (Figure 17.6).



Figure 17.6: Photograph showing cabinet dryer

DAYLIGHT PROCESSOR

In the absence of dark room especially in small dental offices a day light processor can be used.

It consists of a light tight plastic housing which contains three plastic or rubber containers containing developer.

The operator can introduce his hand through the gloved hand inserts open the film and follow the regular manual processing method.

PROCESSING TECHNIQUE

Intraoral and extraoral films once exposed can be processed using two techniques:

1. Manual Processing
 - a. Time temperature controlled method
 - b. Visual method
2. Automatic processing

Manual Processing

It is a known fact that time–temperature processing technique in an adequately quipped and maintained dark room is the best way to ensure optimal film quality.

Guidelines for manual processing (time temperature controlled technique).

1. Ensure that the levels in the developer and fixer tank are adequate (the entire film should submerge into the solutions). The developer solution needs to be replenished every morning with fresh solution. Approximately 60 gm per liter is added to the developer solution to replenish the developer solution.
2. Make sure that the solutions are not too old. (Depleted developer solution appears brownish black. On an average developer and fixing solutions are changed every 15 days (taking into account that approximately 30 intraoral and 5 extraoral films are processed per day)
3. Use a separate stirrer for the developer and fixing solutions and stir the solutions each day in the morning. Stirring will help even distribution of the contents of the solutions and may help in maintaining a constant temperature throughout the solutions.
4. Generally the metal insert containing the developer solution is placed towards the left hand side of the master tank and the fixing solution is placed on the right hand side of the master tank (with the personnel facing the master tank.) However, as the inserts are generally not labeled it is wise to check the solutions before processing the films. This can be done by dipping a finger into one of the tanks and gently rubbing the fingertips, if the solution feels soapy to touch then that solution is the developer solution, as the developer is alkaline in nature.
5. Once the solutions are stirred evenly the temperature of the developer solution is noted down. For intraoral films the manufacturer specifies the development times. Approximately the following time-temperature scale can be used.

Temperature	Time for developing the film
68°F	5 minutes
70°F	4.5 minutes
72°F	4 minutes
76°F	3 minutes
80°F	2.5 minutes

6. Film hanger is selected and ensured that all the clips on the hanger are intact. The hanger should be dry and should not contain any trace of water or processing solutions. The film holder should be thoroughly washed and dried before using it to clip the film, as it might have some amount of fixer solution (from previous use) that may result in white spot due to washing away of undeveloped emulsion. The film packet is opened in the dark room and the film is clipped onto the hanger. The film thus clipped is drawn out of the film packet thereby ensuring that the film does not come in contact with the fingers of the operator, which might obscure diagnostic details on the resultant radiographic image.
7. Once the film is placed in the developing solution, the timer is started. Initially the hanger is gently agitated for a few seconds in order to eliminate any air bubbles on the film. Later the hanger is placed in the developer tank for the predetermined time based on the temperature of the processing solutions. After the preset time, the hanger holding the film is removed gently and all excess developer solution clinging onto the film is let to drain away into the master tank by holding the hanger over the master tank containing water for a couple of seconds.
8. The film is then placed into the master tank containing water for about 30 seconds. The hanger holding the film should be agitated gently so that all the excess developer solution is removed from the film (this halts the developing process) and the fixer solution is not contaminated by the developer solution (contamination of the fixer solution causes the acidic fixer solution to be neutralized by the alkaline developer solution).

9. Once the films are rinsed they are placed in the fixer solution for about 4 minutes. The hanger holding the film is agitated at regular intervals to bring the fixer solution to evenly contact the film.
10. Once the films are taken out of the fixer solution they are held under running water for about 5 minutes ensuring that all the surfaces of the film come under the running water and remnants of the processing solutions are totally washed away. The film is gently shaken to remove water drops clinging onto the surface of the film.
11. The hanger holding films are then dried using a fan or a cabinet dryer.
12. Dried films are ideally mounted before interpreting the films using an illuminated viewer box.

Test to Determine the Quality of the Processing Solutions

Over a period of time the processing solutions deteriorate and need to be changed. On an average the processing solutions need to be changed once in 15 days (this depends on the amount of films processed per day).

An easy method of evaluating the solutions can be done by exposing a dental radiograph and using the freshly prepared solution to process this film. This film can then be used as a reference film. All successive films processed can be compared with this film for contrast and density. Once there is loss of image contrast and density it is indicative that the processing solutions need to be changed.

Manual Processing Technique

Visual method: It is always recommended to use the time temperature controlled method of processing films. However, when the facility of temperature controlled processing is not available, the visual method can be employed.

In this method, there is no predetermined time for which the film is placed in the developer solution. The exposed film is placed in the developer solution and taken out at regular

intervals and examined under the safe light for the most calcified/radiopaque structures to be evident. Once the radiopaque structures are evident (like the enamel cap, restorations, artificial crowns) it indicates the end point of the developing time.

At this point of time the films are taken out of the developer solution, rinsed in water and placed in the fixer solution.

The disadvantages of this technique are inter examiner errors, since evaluating the evidence of most radiopaque structures is very subjective. The commonest errors in this technique are obtaining films of poor density and contrast. Films can be very light or extremely dark making it unfit for diagnostic evaluation.

Automatic Processing

Automatic film processing refers to the processing of radiographs using machines specifically designed for that purpose. The advantages of using an automatic processor are that the need for a dark room is often eliminated. Since, the process is fully automated the process is standardized and controlled hence eliminating human errors. It is also time saving as at the end of the processing cycle (roughly 5 minutes) dry films are obtained which are ready to be mounted and viewed. Most automatic machines have a self replenishing feature thereby eliminating the technique sensitive and cumbersome process of preparing the developer and fixing solutions (Figures 17.7A and B).

However, these machines have inherent disadvantages with regards to the cost, and the need for regular maintenance and cleaning of the rollers. Most automatic processors are not



Figure 17.7A: Intraoral automatic processor



Figure 17.7B: Photograph showing extraoral automatic film processor



Figure 17.8: Construction of an automatic film processor

universal (there are separate machines to process extraoral and intraoral films).

Working Mechanism (Figure 17.8)

Automatic processors are made up of a roller mechanism, which is driven by chains, belts or gears which carry the film through the developer, fixing and water tanks. Motors whose speed can be adjusted drive the rollers. The processor is generally equipped with a daylight loading facility. In such a case the processor can be kept outside the dark room. The function of the roller is to carry the film at a constant preset rate through the processing solutions. The rollers also help in drying the film as they squeeze the processing solutions out of the film.

Composition of the Processing Solutions

Processing solutions that are used to develop radiographs are made up of the developer and fixer solution.

Developer Solution

Functions: To reduce the silver ions in the exposed crystals of silver halide (latent image) to specks of black metallic silver (diagnostic, visible image).

Composition: Developer solution contains *four constituents, which are dissolved in water.*

1. Developer
2. Activator

3. Preservative

4. Restrainer

1. Developer

Function: It converts the exposed silver halide grains to black metallic silver.

Made up of *Phenidone and Hydroquinone*. Phenidone acts as an electron donor and helps in converting the silver ions to metallic silver at the latent image sites. However, in this process Phenidone gets oxidized and becomes inactive. Hydroquinone in the developer solution reduces the oxidized Phenidone thereby helping in its reactivation.

2. Activator

Functions: Activators help in maintaining the alkaline pH of the developer solution and causes the gelatin of the film to swell thereby helping the diffusion of the developing agents into the emulsion and reach the silver halide crystals. Developer solutions are active at an alkaline pH (approximately 10). This alkaline pH is achieved *and maintained by the addition of alkaline agents such as* sodium or potassium hydroxide *and buffers like* sodium carbonate, *sodium hydroxide and sodium metaborate or tetraborate.*

3. Preservative

Functions: It prevents the oxidation of the developer solution by atmospheric oxygen. It also combines with the oxidized developer solution (appears brown) and forms a colorless soluble compound.

The preservative is an antioxidant and is usually *sodium sulfite*.

4. Restrainer

Functions: Acts as an antifog agent. It minimizes/restrains the development of unexposed silver halide grains.

Potassium bromide or sodium bromide is used as the restrainer in the developer solution.

Fixing Solution

Functions: To help in removal of the undeveloped silver halide grains from the emulsion. If the unexposed silver halide grains



remain on the film the radiographic image will appear black and will result in a nondiagnostic image.

Composition: The fixer solution contains *four constituents, which are dissolved in water.*

1. *Clearing agent*
2. *Acidifier*
3. *Preservative*
4. *Hardener*

1. *Clearing agent*

Functions: dissolves and removes the unexposed silver halide crystals from the emulsion of the film. The removal of the unexposed crystals takes place at a controlled slow pace, however fixing for a prolonged time can lead to a gradual loss of film density (silver grains dissolve in acetic acid of the fixing solution)

Aqueous solution of ammonium thiosulphate is used as the clearing agent.

2. *Acidifier*

Functions: The acidifier has two important functions. It helps in the diffusion of ammonium thiosulphate into the emulsion and the exit of silver thiosulphate complex from the emulsion. It inactivates remnants of developer solution that is present over the film thereby halting the developing process of any unexposed silver halide crystals during the process of fixing.

The acidifier used is acetic acid buffer system (pH of 4-4.5).

3. *Preservative*

Functions: It prevents the oxidation of the clearing agent. It also combines with the oxidized developer solution, which is carried over to the fixing solution and thereby preventing staining of the film.

The preservative that is used is sodium sulfite or ammonium sulfite.

4. *Hardener*

Functions: The hardening agents combine with the gelatin and prevent damage to the gelatin during handling of the film. It also reduces the swelling of the emulsion thereby



Figure 17.9: Photograph showing processing solutions in the liquid form



Figure 17.10: Photograph showing processing solutions in powder form

limiting water absorption, which helps in drying the film faster.

Aluminum salts are used as hardeners.

Manual Preparation of the Developer and Fixing Solutions (Figures 17.9 and 17.10)

To make 9 liters of the developer solution

1. Take 5 liters of water in a container (plastic, glass). The water should be at about 38°C
2. Part A (commercially available) of the developer solution is added to the water and stirred well.
3. To Part B (commercially available) of the developer solution is added to the container and mixed well.
4. Finally, water (at room temperature) is added to the above mixture to make up to 9 liters

To make 9 liters of the fixing solution

1. Take 5 liters of water in a container (plastic, glass). The water should be at about 38°C
2. Contents of the commercially available solution is added to the water and stirred well.
3. Finally, water (at room temperature) is added to the above mixture to make up to 9 liters.



Radiographic Faults

Radiographic faults render the film useless for diagnostic purposes. These faults necessitate repeating the particular radiograph, which leads to unnecessary exposure to the patient and the loss of precious time both to the patient and the dental surgeon.

There are a wide variety of reasons that cause faulty radiographs. However, all radiographic faults can be rectified once the causes for the faults are understood.

CAUSES FOR FAULTY RADIOGRAPHS

- I. Errors in film storage and handling
- II. Errors in film placement and projection technique
- III. Errors in exposure parameters and processing technique
- IV. Artifacts

Errors in Film Storage and Handling

1. Film fog (seen as a dark radiograph)
 - a. Films stored at high temperatures and humidity
 - b. Out dated films
 - c. Films exposed to radiation
2. Emulsion peel (Figure 18.1)
 - a. Wet film in contact with finger nails
3. Dark spots or lines
 - a. Finger print contamination

Errors in Film Placement and Projection Technique

1. Herring bone effect (tyre mark pattern) (Figure 18.2)
 - a. Wrong side (opposite side) of the film exposed to radiation
2. Cone cut (Figure 18.3)
 - a. Improper placement of film
 - b. Improper positioning of the position indicating device (film partially outside the area covered by the PID)
3. Overlapping of image (Figure 18.4)
 - a. Improper horizontal angulation
4. Shortened image (Figure 18.5)
 - a. Increased vertical angulation (Bisecting angle technique)
 - b. Film not placed parallel to the long axis of the tooth (Paralleling technique)
5. Elongated image (total) (Figure 18.6)
 - a. Decreased vertical angulation (Bisecting angle technique)
 - b. Film not placed parallel to the long axis of the tooth (Paralleling technique)
6. Elongated image (partial)
 - a. Excessive bending of the film
7. Blurred image (Figure 18.7)
 - a. Movement of the film or patient during the exposure (image totally blurred)
 - b. Excessive bending of the film (image partially blurred)
8. Slanting of the occlusal plane
 - a. Improper placement of the film
9. Apical ends of the teeth not imaged
 - a. Insufficient vertical angulation
 - b. Film not placed deep into the palatal vault or lingual vestibule
10. Crown portion of teeth not imaged (Figure 18.8)
 - a. Improper placement of film

Errors in Exposure Parameters and Processing Technique

Dark Radiograph (Figure 18.9)

- a. *Exposure errors*

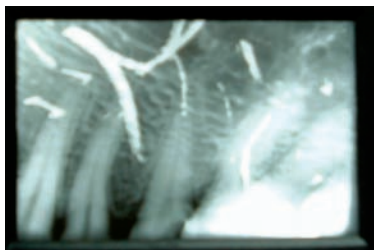


Figure 18.1: Photograph showing emulsion peel

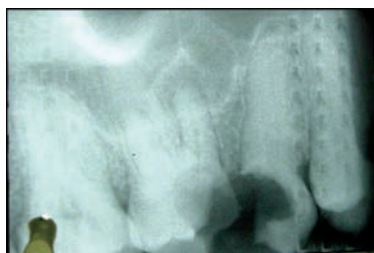


Figure 18.2: Photograph showing tyre mark pattern

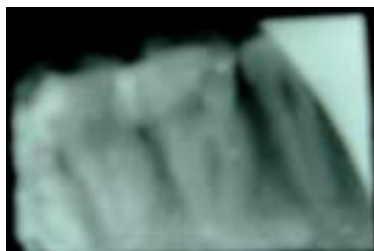


Figure 18.3: Photograph showing cone cut



Figure 18.4: Photograph showing overlapped image



Figure 18.5: Photograph showing foreshortened image

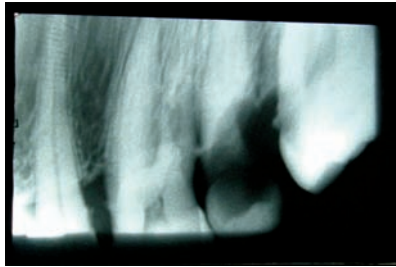


Figure 18.6: Photograph showing elongated image



Figure 18.7: Photograph showing blurred image



Figure 18.8: Photograph showing improper placement of film



Figure 18.9: Photograph showing dark radiograph

- i. Excessive mA
- ii. Excessive kVp
- iii. Excessive exposure time
- iv. Insufficient film-x ray source distance
- b. *Processing errors*
 - i. Developer temperature too high
 - ii. Film developed for a longer time
 - iii. Concentration of the developer too high
 - iv. Accidental exposure to light
 - v. Improper safe lighting

Light Radiographs (Figure 18.10)

- a. *Exposure errors*
 - i. Insufficient mA
 - ii. Insufficient kVp
 - iii. Insufficient exposure time
 - iv. Film packet placed with the wrong side facing the x ray source



Figure 18.10: Photograph showing light radiograph

- v. Increased film source distance
- b. *Processing errors*
 - i. Placed in the developer solution for a short duration of time
 - ii. Temperature of the developer solution too low
 - iii. Depleted developer solution
 - iv. Diluted or contaminated developer solution
 - v. Excessive fixation

Film Fog

- a. Improper wattage of the safe light
- b. Prolonged exposure of the film to safe light
- c. Safe light not at a proper distance from the working place
- d. Light leaks- from cracked safe light filters/ light from doors and ventilators

Insufficient Contrast

- a. Underexposed to radiation
- b. Insufficient developing time

Yellow or Brown Stains (Figure 18.11)

- a. Film inadequately fixed
- b. Depleted developer solution
- c. Depleted Fixer solution

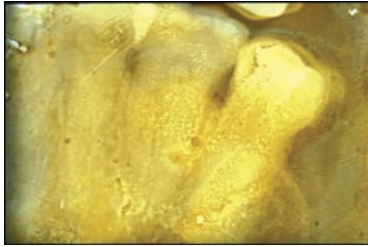


Figure 18.11: Photograph showing yellow/brown stains

- d. Film inadequately washed in water
- e. Contaminated processing solutions

Artifacts

Artifact is a structure or radiographic appearance that is normally not present in the radiograph and which is produced by artificial means.

Blank Radiograph (Figure 18.12)

- 1. Unexposed film
- 2. Exposed film dipped into the fixer solution before it was placed into the developer solution

Partial Image

- 1. Part of the film not immersed into the developer solution

Blisters on the film

- 1. Air bubbles on the film while developing
- 2. Temperature difference between the developer and fixer solutions
- 3. Increased acidity of the developer solution

Static electricity artifact

- 1. Forceful unwrapping of the film from the packet or from the cassette

Nail mark artifact

- 1. Excessive bending of the film



Figure 18.12: Photograph showing unexposed film

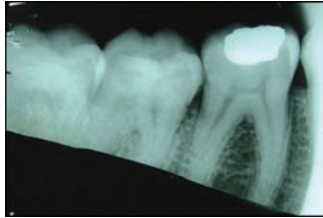


Figure 18.13: Photograph showing dark spot

Dark spots on the radiograph (Figure 18.13)

1. Film contaminated with the developer solution before the actual processing
2. Film in contact with another film or tank walls during the fixing procedure
3. Excessive bending of the film
4. Finger prints

Light spots on the radiograph (Figure 18.14)

1. Film contaminated with the fixer solution before the actual processing (remnants of fixing solution present on the hangers for processing will cause this artifact)
2. Film in contact with the tank wall or another film during the developing process

Foreign body image on the radiograph

1. Radiopaque material in the path of the x-ray beam (ear rings, nose studs) (Figure 18.15)
2. Placement of the finger between the x-ray tube and the film (such as using the finger to stabilize the film in the mouth)

SALVAGING DARK RADIOGRAPHS

Radiographs which are too dark contribute towards the most common faults in dental radiography. Various methods of reducing, or lightening, dark films have been advised. The most famous of these is that described by E. Howard Farmer in 1884.

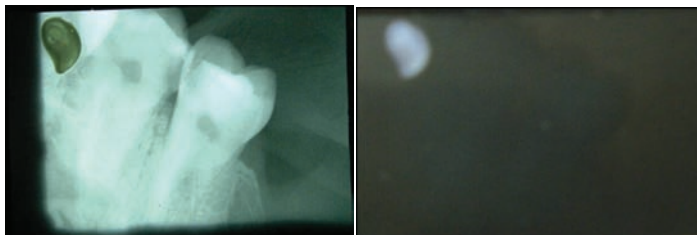


Figure 18.14: Photograph showing light spot

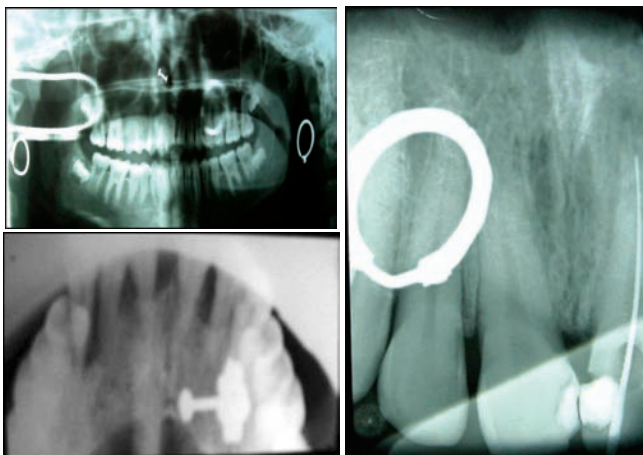


Figure 18.15: Photograph showing foreign body artifact

Potassium ferricyanide reacts with the silver of the radiograph to produce silver ferrocyanide and potassium ferrocyanide. The silver ferrocyanide is then made soluble by its reaction with thiosulphate, and thus can be removed from the film. By washing a dark radiograph with this solution the film is made lighter. However, this particular reducer is considered dangerous because it contains potassium ferricyanide. In view of this and its short shelf life (approximately 30 minutes) potassium ferricyanide should not be used without due consideration.

Cyanide is a dangerous chemical: it must be treated with respect and disposed of in the correct way.

Other reducers can be made containing other metals, for example potassium permanganate and potassium dichromate. However, these solutions are often not stable and have short shelf lives.

Wakefield in 1970, described a single solution reducer with a very long shelf life. The Wakefield reducing solution has been modified for ease of use and thus made more acceptable and appropriate for use in dental radiography.

The Reducing Solution (Modification of Wakefield Solution)

The chemicals required are easily obtainable. The following are mixed with care in the order they are listed, in a glass or ceramic container (the acid will destroy a metal or plastic container) (Figure 18.16).

Copper sulphate crystals (5 ml)

Sodium chloride (5 ml)

Hydrochloric acid (concentrated) (5 ml)

Water (200 ml)

An old teacup or beaker makes an appropriate vessel. The acid must be added to the water because the strong isothermic reaction could spray concentrated acid around if the water were added to the acid. Once the reducing solution has been made it will last almost indefinitely.

LIGHTENING A FILM

To lighten a film, which has been, overexposed or over-developed and dried, it should first be soaked in water to soften the emulsion. Then, holding the film by its edge using plastic or metal tweezers, it is rinsed in the reducing solution. The procedure can be undertaken in normal visible light conditions. The film will turn a whitish colour as silver chloride is produced on the surface of the film. The film should be assessed at regular intervals, by direct vision, in order to control the rate of

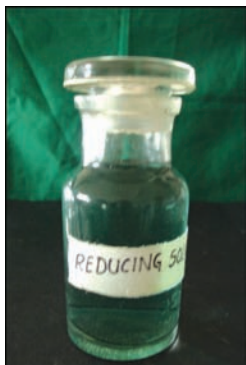


Figure 18.16: Photograph showing reducing solution

reduction. The reduction process should take between 4 to 10 seconds, depending on the density of the radiograph. The film is then rinsed rapidly in cold water, and fixed in the normal fixing solutions. Finally, the film is washed and dried.

It may be necessary to dilute the reducing solution further in order to obtain a more controlled reduction process. Trial films should be used initially to ensure that the image on the film to be reduced is not lost completely. If over-reduction has taken place and the film has not been fixed, the film should be washed and developed in the normal developing solution, then re-reduced and fixed. However, this will result in a slight loss of detail.

Alternate Technique of Lightening Dark Radiographs (Figure 18.17)

Although this crude technique is not generally recommended, it is very effective in lightening dark radiographs and may help in salvaging a non-diagnostic dark film.

The dark radiograph, if dry should be placed in the fixer tank for few minutes. The film should then be placed on an even surface. A sharp Bard Parker blade should be used to scrape away emulsion on one side of the film in even regular strokes. Once all the emulsion on one side of the film is removed

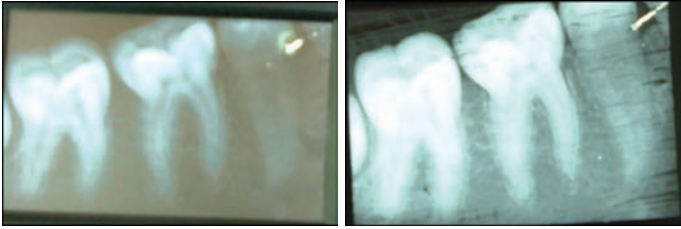


Figure 18.17: Photograph showing lightening a dark radiograph by removing the emulsion one side of the film

should be thoroughly rinsed under running tap water and dried.

However, one should be cautious not to scrape emulsion on both sides of the film as this will result in loss of radiographic image. Uneven removal of the emulsion will result in image with scratches.



Normal Radiographic Anatomical Landmarks

Radiographic diagnosis requires the clinician to distinguish what is abnormal from normal radiographic anatomy. The radiologist should be theoretically and practically sound to differentiate/identify minute variations in the radiographic anatomy.

Anatomical landmarks can be studied as:

Anatomic landmarks common to both the maxilla and mandible

Landmarks unique to the maxillary radiograph

Landmarks unique to the mandibular radiograph

ANATOMIC LANDMARKS COMMON TO THE MAXILLA AND MANDIBLE (FIGURE 19.1)

Teeth—enamel cap, dentine, cementum and pulp

Lamina dura

Alveolar bone—crestal bone, trabecular bone

Periodontal ligament space

Teeth

Enamel cap appears more radiopaque than other structures because it is 90% mineralized. Dentine

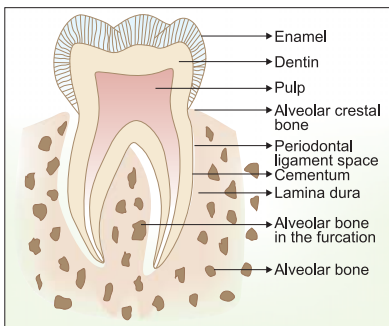


Figure 19.1: Normal radiographic anatomy common to the maxilla and mandible

is smooth and homogenous and radiographically has the density of bone. Dentine about 75% mineralized.

Cementum is not appreciated radiographically because the contrast between it and dentine is minimal. Cementum is 50% mineralized.

Pulp appears radiolucent. The coronal pulp (pulp chamber) extends inferiorly into the roots, which is referred to as radicular portion of pulp.

Intraoral periapical radiographs frequently reveal radiolucent areas on the proximal aspects of teeth in the cervical region between the crest of the alveolar ridge and the enamel cap. These areas mimic proximal carious lesions. Such a radiographic appearance is referred to as cervical burnout. This phenomenon is caused by decreased x-ray adsorption in the proximal areas of teeth owing to their anatomic contours.

In a developing tooth, the pulp canal diverges and the walls of the root taper to a knife edge. A small round area of radiolucency is seen at the root tip which is surrounded by a thin layer of hyperostotic bone. These findings represent the dental papilla surrounded or enclosed by the bony crypt.

Lamina dura

Lamina dura is a radiographic term used to describe alveolar bone proper, which forms the sockets of teeth. It is also considered to be a 'specialized' continuation of the cortical plate. Radiographically, lamina dura is seen as a well defined radiodense layer of bone that surrounds the roots of teeth in health. The appearance of lamina dura on a radiograph is because of the attenuation of the x-ray beam as it passes through the thin layer of bone tangentially.

Usually lamina dura is well defined. However on occasions, even in a healthy tooth lamina dura may appear indistinct and diffuse because of an obliquely directed x-ray beam. Lamina dura is generally more radiodense and thick around the roots of teeth under heavy occlusal forces. A double lamina dura is seen when the surfaces of the mesial and distal root are in the path of the central beam of the x-ray.

Alveolar Crest

Crest of the alveolar bone is a radiopaque structure. It is seen as a continuation of the lamina dura. The junction between the alveolar crest and lamina dura is seen as a sharp well defined angle. Generally the crest of the alveolar ridge is 1.5 mm apical to the cemento-enamel junction. In the anterior teeth the alveolar crest terminates as a pointed projection. In the posterior region it appears reasonably flat and parallel to the cemento-enamel junction.

Periodontal Ligament Space

The periodontal ligament space is seen as a radiolucent area between the root and the lamina dura. It is seen all around the root extending from the alveolar crest on one side to the other. The width of the periodontal ligament space varies from 0.15 mm to 0.36 mm; it is generally thinner in the middle third of the root and wider near the alveolar crest and the apical region of the root.

Cancellous Bone

It is present between the buccal and lingual cortical plates in the maxilla and the mandible. The cancellous bone is made up of a network of radiopaque trabeculae that enclose minute radiolucent bone marrow spaces.

In the anterior region of the maxilla the trabeculae are fine and dense and in the posterior region the bone marrow spaces are relatively larger than the anterior region. In the anterior region of the mandible the trabeculae are fewer in number and oriented horizontally. In the posterior region the mandible the bone marrow spaces are larger.

Intermaxillary Suture / Median suture

Radiographic Location

It is seen between the premaxillae. The intermaxillary suture runs from the alveolar crest between the maxillary central incisors

to the posterior aspect of the hard palate.

Radiographic appearance (Figure 19.2)

It is seen as a linear radiolucency bounded by radiopaque lines extending from the crest of the alveolar bone between the maxillary central incisors to the anterior nasal spine on an intraoral periapical radiograph (IOPAR). Occasionally it is seen as a v-shaped enlargement at the alveolar crest.

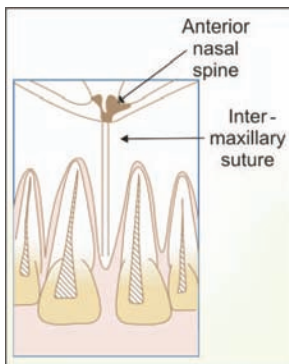


Figure 19.2: intermaxillary suture and anterior nasal spine

Anterior Nasal Spine

Radiographic Location

Seen on an IOPAR at the junction of the nasal septum and the floor of the nasal fossa. It is usually seen approximately 2 cm above the alveolar crest.

Radiographic Appearance (Figure 19.2)

It is a v-shaped radiopaque structure.

Nasal Fossae and Floor of the Nasal Fossa

Radiographic Location

The inferior portion and floor of the nasal fossae are seen on an IOPAR beyond the periapical regions of the maxillary anterior teeth.

Radiographic Appearance (Figure 19.3)

The floor of the nasal fossae appear as well defined radiopaque lines that extend bilaterally in either side of the anterior nasal spine. The radiolucent region above the floor of the nasal fossae is the inferior portion of the nasal fossa.

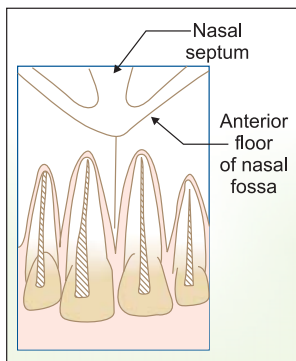


Figure 19.3: Anterior floor of nasal fossa and nasal septum

Nasal Septum

Radiographic Location

It is seen on periapical radiographs taken in relation to maxillary central incisors. It is a midline structure and seen extending superiorly from the anterior nasal spine.

Radiographic Appearance (Figure 19.3)

The nasal septum is a sharply defined linear radiopacity, which may generally appear to be deviated from the midline. However, on occasions the image of septal cartilage and the vomer bone may be superimposed over the nasal septum.

Incisive foramen / nasopalatine foramen / anterior palatine foramen

Radiographic Location

Incisive foramen is seen in relation to the middle and apical one third of the roots of the maxillary central incisors.

Radiographic Appearance (Figure 19.4)

It is radiolucent and may appear smoothly symmetric, with numerous forms, or very irregular, with a well-demarcated or ill-defined border, with a diameter less than 1cm.

Tip of the Nose

Radiographic Location

The image of the tip of the nose is superimposed over the apical one-third of the roots of the maxillary central and lateral incisors.

Radiographic Appearance (Figure 19.4)

It appears as a homogenous radiopacity with a definite outline.

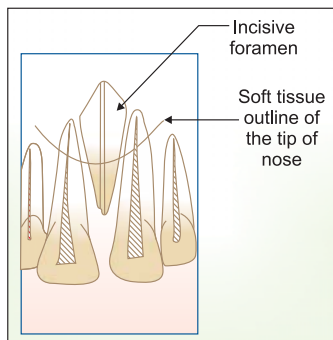


Figure 19.4: Incisive foramen and soft tissue outline of tip of the nose

Lateral Fossa/ Incisive Fossa

Radiographic Location

It is seen in relation to the apical region of the maxillary lateral incisor

Radiographic Appearance (Figure 19.5)

It appears as a diffuse radiolucency.

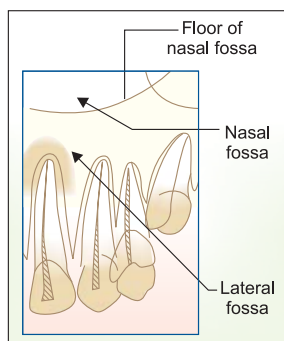


Figure 19.5: lateral fossa

Nasopalatine Canal

Radiographic Location

The nasopalatine canal is rarely seen on periapical radiographs. However, they may be evident on radiographs taken in relation to the maxillary central incisors.

Radiographic Appearance (Figure 19.6)

The lateral walls of the nasopalatine canal appear radiopaque and extend from the incisive foramen to the floor of the nasal fossa.

Superior Foramina of the Nasopalatine Canal*Radiographic Location*

Generally seen on maxillary occlusal radiographs or on a periapical radiograph when taken with an increased vertical angulation.

Radiographic Appearance (Figure 19.7)

They appear as well defined oval radiolucencies on either side of the nasal septum (superimposed close to the floor of the nasal fossa).

Nasolacrimal Canal*Radiographic Location*

Rarely visualized on a periapical radiograph. When and increased vertical angulation is used, the nasolacrimal canal may be seen in the periapical region of the canine. In maxillary occlusal radiographs they are seen in relation to the apices of the molars.

Radiographic Appearance (Figure 19.8 A and B)

Well-defined ovoid/round radiolucencies.

Nasolabial Fold*Radiographic Location*

The nasolabial fold is seen extending across the middle and apical one-third of the roots of the canine and first premolar.

Radiographic Appearance (Figure 19.9)

The nasolabial fold appears as a linear radio-dense shadow. An area of increased radiopacity is seen beyond this line, which is

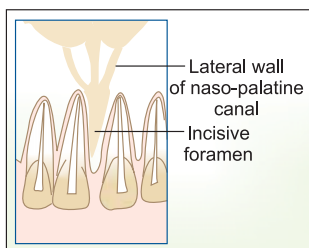


Figure 19.6: Lateral wall of the nasopalatine canal and incisive foramen

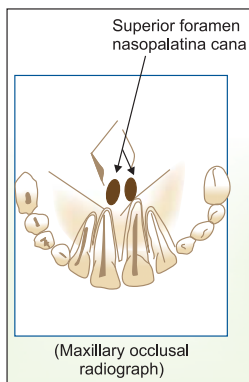


Figure 19.7: Superior foramen of nasopalatine canal

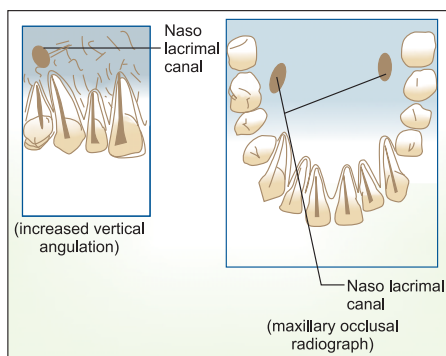


Figure 19.8: Nasolacrimal canal

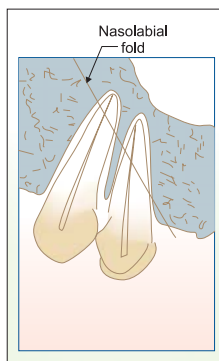


Figure 19.9: Nasolabial fold

produced by the superimposition of the buccal mucosa and alveolus.

Maxillary Sinus

Radiographic Location

The floor and a minimal portion of the inferior aspect of the maxillary sinus are seen on periapical radiographs taken in relation to the maxillary premolar and molar teeth.

Radiographic Appearance

The maxillary sinus appears as a uniformly radiolucent structure bounded by well defined thin radiopaque line. In relation to the periapex of the canine, the floor of the maxillary sinus and the floor of the nasal fossa cross one another forming an inverted Y, which is referred to as Y line of Innes (Figure 19.10).

The roots of the maxillary molars 'appear' to project into the maxillary antrum as a result of the angulation of the x-ray beam (Figure 19.11).

In edentulous spaces the floor of the sinus dips down and lies close to the alveolar ridge (pneumatization of the sinus). Occasionally thin radiolucent lines are seen to traverse the sinus walls. These radiolucent tracks represent the neural and vascular supply of the sinus.

Zygomatic Process and Zygomatic Bone

Radiographic Location

The zygomatic bone and the zygomatic process of the maxilla are seen in the periapical regions of the second and third molars. Zygomatic bone is seen when an excessive vertical angulation is used.

Radiographic Appearance (Figure 19.12)

The zygomatic bone is seen as a homogenous radiopacity over the apices of the second and third molars, generally obscuring the periapical region.

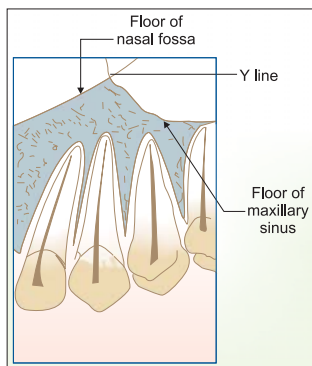


Figure 19.10: Y line

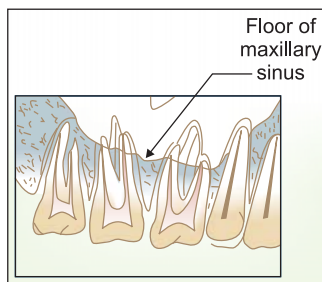


Figure 19.11: Floor of maxillary sinus

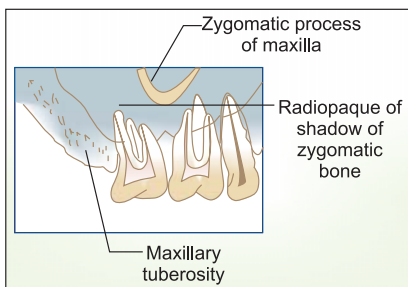


Figure 19.12: Zygomatic process of maxilla and zygomatic bone

Zygomatic process of the maxilla is seen above the level of the floor of the maxillary sinus in relation to the apices of the molar teeth. It is seen as a u-shaped or v-shaped radiopaque line.

Pterygoid Plates and Hamular Process

Radiographic Location

The pterygoid plates and hamular process are seen distal to the maxillary tuberosity. They are generally seen on intraoral periapical radiographs taken in relation to the third molars. However in most cases they may not be evident.

Radiographic Appearance (Figure 19.13)

The pterygoid plates are seen as a radiopaque shadow distal to the maxillary tuberosity and the hamular process is evident as a single radiopaque linear structure extending from the inferior aspect of the medial pterygoid plate.

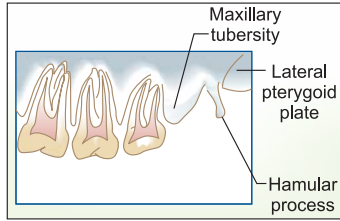


Figure 19.13: Maxillary tuberosity, lateral pterygoid plates and hamular process

ANATOMIC LANDMARKS UNIQUE TO MANDIBLE

Symphysis
Genial tubercles
Mental ridge
Mental fossa
Mental foramen
Mandibular canal
Nutrient canals
Mylohyoid ridge
Submandibular gland fossa
External oblique ridge
Inferior border of mandible
Coronoid process

Symphysis

Radiographic Location

It is seen only in the first year of life. It is seen in the region corresponding to the midline of the mandible (Figure 19.14)

Radiographic Appearance

It is seen on the radiographs of the deciduous mandibular central incisors. Symphysis appears as a linear radiolucency between the deciduous mandibular central incisors.

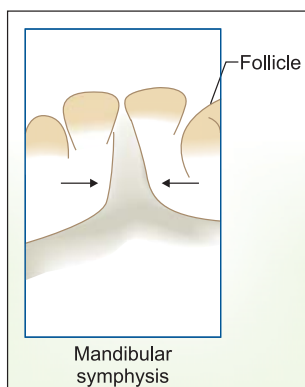


Figure 19.14: Mandibular symphysis

Genial Tubercles/Mental Spine

Radiographic Location

They are generally evident on the periapical radiographs of mandibular central incisors and on mandibular occlusal radiographs.

Radiographic Appearance

Genial tubercles are seen on mandibular occlusal radiographs as discrete radiopaque structures measuring about 4 mm in diameter. They are present beneath the apices of the mandibular central incisors in the midline.

In periapical radiographs they are seen as a well defined radiopaque mass enclosing a circular radiolucent area which is referred to as the lingual foramen (the lingual foramen carries the incisal branches of the mental nerve (Figure 19.15).

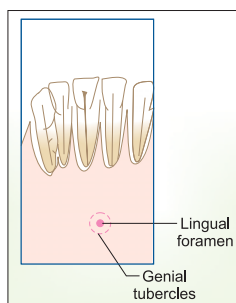


Figure 19.15: Genial tubercles and lingual foramen

Mental Ridge

Radiographic Location

Mental ridge is seen superimposed over the apical one-third of the roots of the mandibular central and lateral incisors. It appears to extend from the premolar region upto the central incisors.

Radiographic Appearance

Seen on periapical radiographs as two well defined radiopaque lines extending bilaterally from the premolar region towards the midline (Figure 19.16).

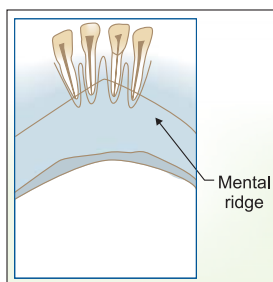


Figure 19.16: Mental ridge

Mental Fossa

Radiographic Location

The mental fossa is an anatomical depression present on the labial aspect of the mandible extending bilaterally from the midline to the lateral incisor and occasionally up to the canine.

Radiographic Appearance

It is seen as a diffuse radiolucent area, which is superimposed over the roots of the mandibular anterior teeth. The mental fossa is bounded superiorly by the alveolar ridge and inferiorly by the mental ridge (Figure 19.17).

Mental Foramen

Radiographic Location

The mental foramen is usually seen at the periapical regions of mandibular premolars. It is usually present equidistant from the both the lower border of the mandible and the alveolar ridge.

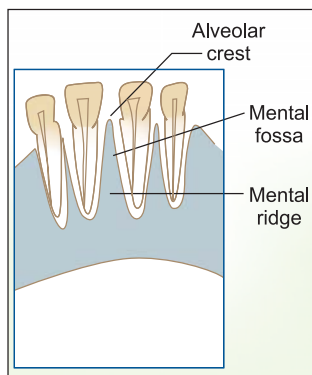


Figure 19.17: Mental fossa

Radiographic Appearance

It appears radiolucent and has a round, ovoid or an elongated shape. It may or may not have a well defined radiopaque corticated border (Figure 19.18).

Nutrient Canals

Nutrient canals are generally not distinct on a radiograph. These canals carry the neurovascular supply to the tooth. Review of literature reveals that these canals are distinct in older individuals, patients with high blood pressure and severe periodontitis.

Radiographic Location

Nutrient canals are usually seen at the periapices of mandibular anterior teeth.

Radiographic Appearance (Figure 19.18)

They appear as linear tubular radiolucencies extending from the apical foramen or the interdental bone. They may occasionally be lined by radiopaque corticated borders.

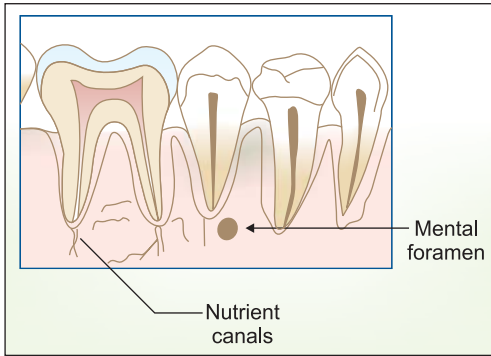


Figure 19.18: Mental foramen and nutrient canals

Mandibular Canal

Radiographic Location

The mandibular canal is usually seen on periapical projection of mandibular molars. The apices of the molar teeth may some times lie close to the canal.

Radiographic Appearance (Figure 19.19)

It is seen as linear radiolucent canal running along the apices of the molar teeth. The course of the canal is generally lined by thin radiopaque lamellae of bone.

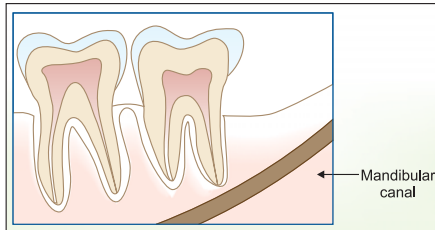


Figure 19.19: Mandibular canal

Mylohyoid Ridge

Radiographic Location

The mylohyoid ridge is seen extending from the third molar region to the premolars usually along the apices of these teeth.

Radiographic Appearance (Figure 19.20)

It is seen as a well demarcated radiopaque line or as a diffuse radiopaque shadow superimposed over the apices of the molar teeth.

Inferior Border of the Mandible

Radiographic Appearance (Figure 19.20)

The inferior border of the mandible is rarely seen on intraoral periapical radiographs. It is evident as a radiodense strip of bone.

External Oblique Ridge

Radiographic Location

It is seen on IOPARs of mandibular posterior teeth. The external oblique ridge is seen above and parallel to the mylohyoid ridge.

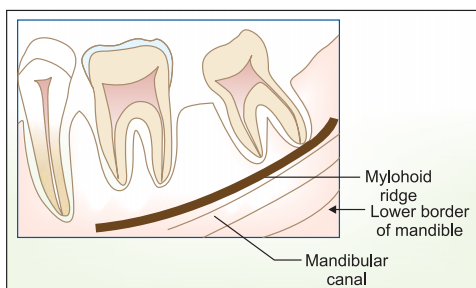


Figure 19.20: Mylohyoid ridge, lower border of mandible

Radiographic Appearance (Figure 19.21)

The external oblique ridge appears as a linear radiopacity which merges with the alveolar bone as it traverses towards the premolar region.

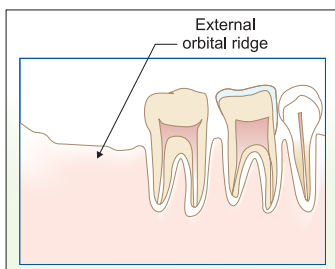


Figure 19.21: External oblique ridge

Submandibular Gland Fossa

The submandibular gland fossa is an anatomic depression that houses the submandibular gland.

Radiographic Location

The submandibular gland fossa is seen in the periapical region of molar teeth, below the level of the mylohyoid ridge. It extends up to the premolar region anteriorly and to the ascending ramus posteriorly.

Radiographic Appearance (Figure 19.22)

It appears as a diffuse radiolucency.

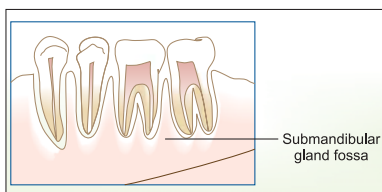


Figure 19.22: Submandibular gland fossa

Coronoid Process

Radiographic Location

The coronoid process of the mandible is usually seen superimposed over the periapical regions of the 2nd and 3rd maxillary molars and sometimes over the maxillary tuberosity region. The position of the image on the radiograph depends on the extent to which the mouth was opened during the radiographic projection.

Radiographic Appearance (Figure 19.23)

The coronoid process appears as a homogeneous triangular shaped radiopacity.

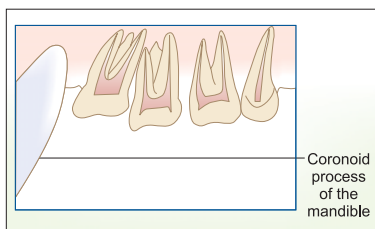


Figure 19.23: Coronoid process of the mandible

RADIOPAQUE ANATOMICAL LANDMARKS

- Enamel cap
- Dentin
- Cementum
- Lamina dura
- Alveolar bone (bone trabeculae)
- Alveolar crest
- Anterior nasal spine
- Floor of nasal fossa
- Tip of nose, nasolabial fold
- Floor of maxillary sinus
- Zygomatic process of maxilla
- Zygomatic bone
- Maxillary tuberosity
- Pterygoid plates
- Hamular process
- Coronoid process
- Genial tubercles
- Mental ridge
- Mylohyoid ridge
- External oblique ridge
- Inferior border of the mandible



RADIOLUCENT ANATOMIC LANDMARKS

Pulp
Periodontal ligament space
Bone marrow space
Intermaxillary suture
Nasal fossa
Incisive foramen
Superior foramina of nasopalatine canal
Lateral fossa/ Incisive fossa
Nasolacrimal canal
Maxillary sinus
Symphysis
Lingual foramen
Mental foramen
Mandibular canal
Nutrient canal
Submandibular gland fossa



Interpretation of Radiographs

Radiographic interpretation forms the basis for radiographic diagnosis. The objective of interpreting a radiograph should be to differentiate normal structures from abnormal findings on the radiograph.

GENERAL GUIDELINES FOR INTERPRETING RADIOGRAPHS

Apart from a thorough knowledge of the normal anatomical structures and their variations the dental physician attempting to interpret radiographs requires certain basic infrastructural tools such as a view box, a source producing light of great intensity (to view dark radiographs) and a magnifying glass to enable examination of minute details on a radiograph

1. Ideally extraneous light in the room should be shut out. All intraoral films should be mounted for viewing.
2. Always interpret the radiograph using a view box (Figure 20.1).
3. It is always recommended to use view boxes of standard sizes meant for intraoral and extraoral radiographs respectively (Figure 20.2).
4. Of the viewer box is larger than the radiographs film. A black card paper/or a thick opaque sheet of paper can be used to cover the areas around the film.
5. Sometimes a bright source of light may be required to evaluate dark areas on a radiograph.
6. Use of magnifying glass is advisable when evaluation of minute details is required.



Figure 20.1: Photograph showing view box for extraoral radiographs



Figure 20.2: Photograph showing view box with a magnifying glass for intraoral radiographs

SEQUENCE FOR VIEWING INDIVIDUAL TOOTH IN A RADIOGRAPH

Crown

1. Trace the outline of the edge of the enamel cap
2. Trace the outline of the Enamel-Dentine Junction
3. Note any alteration in the outline shape, possibility of a carious lesion.
4. Note any alteration in the interproximal enamel density, e.g. radiolucent triangular shadows caused by caries
5. Note any alteration in the dentine density, e.g.:
 - Radiolucent saucer-shaped shadows of:
 - i. Proximal caries
 - ii. Occlusal caries
 - Radiolucent oval/round shadows of:
Superimposed smooth-surface buccal/lingual caries
6. Note the presence and state of existing restorations, e.g.:
 - Overcontoured
 - Undercontoured
 - Adaptation
 - Ledges/overhangs
 - Recurrent caries

7. Trace the outline/shape of the pulp chamber and note:
 - Size of the pulp chamber
 - Presence of reactionary dentine
 - Presence/number of pulp stones
 - Presence of calcified root canals

Cervical Region and Root Portion of the Tooth

1. Trace the outline of the neck and cervical 1/3 of the root of the tooth
2. Note any alteration in the outline, e.g. possible cavitation caused by root caries
3. Note any alteration in the density of the root dentine e.g.:
 - Radiolucent saucer-shaped shadow of root caries
 - Radiolucent triangular-shaped shadows of cervical burn-out or cervical translucency
4. Evaluate the furcation area. Note amount of bone resorption

Periapical Region

1. Evaluate whether the periodontal ligament space is normal/widened
2. Trace the lamina dura around the root. Is it discontinuous?
3. Mention the presence of radiolucency/radiopacity at the peri apex of the tooth

Radiolucency

1. Tooth associated radiolucency/nontooth associated radiolucency
2. Ill defined/diffuse radiolucency
3. Well defined radiolucency
 - a. Less than 1.5 cm in diameter/larger than 1.5 cm in diameter
 - b. Bounded by sclerotic border

Radiopacity

1. Tooth associated/non-tooth associated



2. Well defined radiopacity
3. Diffuse radiopacity

Interpretation of Intraoral Periapical Radiograph (Data Sheet)

Name:

Age:

Sex:

OP. No.

Radiograph Asked for

Radiograph Shows

Interpretation

1. Crown:
2. Root:
3. Periodontal Ligament Space:
4. Lamina Dura:
5. Periapical Area:
6. Alveolar Bone:
7. Normal Anatomical Landmarks:
8. Radiographic Fault:
9. Radiographic Diagnosis:

RADIOGRAPHIC EXAMINATION OF DENTAL CARIES

Carious process causes tooth demineralization. These demineralized areas of the tooth allows greater penetration of x-rays and these areas appear black (dark) on a radiograph or radiolucent than the unaffected portion. Radiographs are useful for detecting proximal caries when the teeth are in contact

and cannot be directly inspected. It also helps in detecting the periapical changes due to carious process. It should also be noted that in early carious lesions where there is no sufficient demineralization it is difficult to detect the lesions radiographically. It is also equally important to utilize the optimal viewing conditions to interpret the radiographs.

Radiographic Examination of Dental Caries Includes

- Bitewing radiograph
- Intraoral periapical radiograph
- Orthopantomogram

Posterior bitewing radiographs are the most useful x-ray projections for detecting caries in the distal third of a canine and the interproximal and occlusal surfaces of premolars and molars. Periapical radiographs are useful in detecting the periapical changes and the interradicular bone. Use of paralleling technique for obtaining periapical radiographs increases the value of this technique in detecting caries of both anterior and posterior teeth.

Radiographic Appearance of Caries

Occlusal Caries (Figure 20.3)

Incipient lesion: Radiographs are usually not effective for detection of occlusal caries until it reaches dentin. The incipient lesions present little or no radiographic evidence. A fine gray shadow just below the dentino-enamel junction may be the only detectable evidence of an early lesion. However, similar but usually less broad shadow is frequently apparent on the images of the unaffected teeth below the occlusal enamel. This line of increased density at the junction represents an optical illusion referred to as a mach band.

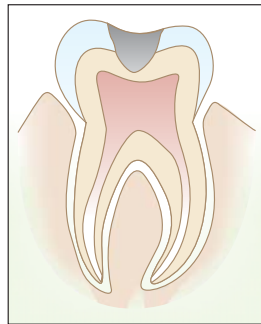


Figure 20.3: Occlusal caries

Moderate Occlusal Caries

Moderate occlusal caries usually have radiographic changes. It appears as a broad based, thin radiolucent zone in the dentin with little or no changes apparent on the enamel. Another significant manifestation of occlusal caries in the dentin is a band of increased opacity between the lesion and pulp chamber. This light band, which represents calcification within the primary dentin, is usually not seen in buccal caries.

Severe Occlusal Caries

Severe occlusal caries are detected readily both clinically and radiographically. As the carious lesions enlarge, they appear as different areas of radiolucency in the crowns of the affected tooth. These patterns are fairly characteristic and vary according to the site and size of the lesions.

Proximal Caries (Figure 20.4)

Radiographic detection of carious lesions on the proximal surfaces of teeth also depends upon the amount of demineralization. Because the proximal surfaces of posterior teeth are often broad, the loss of amounts of mineral from incipient carious lesions or advancing front of the advanced lesions is difficult to detect. For this reason it is always important to know that the actual depth of the carious lesions is deeper than what is seen in a radiograph. Approximately 40% of demineralization is required for radiographic detection of a lesion.

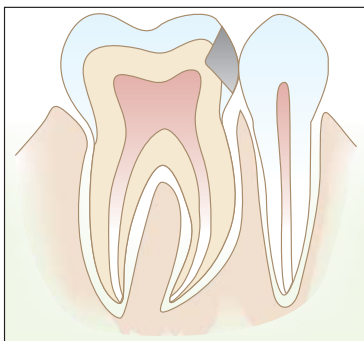


Figure 20.4: Proximal caries

Incipient Proximal Lesion

The early lesions are radiolucent and do not appear radiographically until they penetrate more than half the thickness of the enamel. The early lesion may be seen as radiolucent “notch” on the outer surface of the tooth. A magnifying glass may be used to detect the extent of the lesion.

Moderate Proximal Lesion

These lesions are those that involve more than half of the enamel but are not seen radiographically to extend into dentino-enamel junction. These have three radiographic appearances:

- *Triangle with its broad base at the outer surface of the tooth (most common)*
- *Diffuse radiolucent image (less common)*
- *Combination of the above two.*

Advanced Proximal Lesions

These are the lesions that have invaded the dentino-enamel junction. It appears as a radiolucent image penetrating through the enamel. The lesion may appear triangular, diffuse or combination of both. The demineralization process spreads at the dentino-enamel junction extending into the dentin. This forms a second triangular radiolucent image in the dentin with its broad base at the dentino-enamel junction and its apex directed toward the pulp cavity. Occasionally lesions that have penetrated into the dentin appear not to have penetrated from the enamel.

Severe Proximal Lesions

Severe proximal lesion is one that have penetrated more than half the dentin and nearing the pulp. It shows a narrow path of destruction through the enamel, an expanded radiolucent image at the dentino-enamel junction. Pulpal exposure of the carious lesions should be correlated with the clinical findings.

Recurrent Lesion/Secondary Caries (Figure 20.5)

Recurrent caries occurs immediately next to restoration. It may result because of poor adaptation of the restoration, which allows the marginal leakage. The radiographic appearance of recurrent caries depends on the amount of demineralization present and whether a restoration is obscuring the lesion. Radiopaque restorations often hide small and large demineralized areas. Mesiogingival, distogingival, and occlusal margins are most frequently identified while facial buccal and lingual is difficult unless there is considerable amount of destruction.

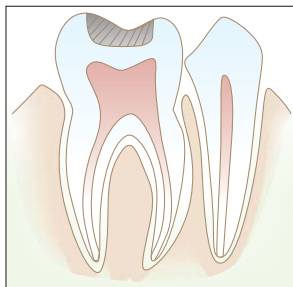


Figure 20.5: Recurrent caries

Root Surface Caries (Cemental caries) (Figure 20.6)

Root surface caries involves cementum and dentin. It appears as ill-defined saucer like radiolucent images. When the peripheral surface area is small, the appearance of the lesion is more notched than the saucer like.

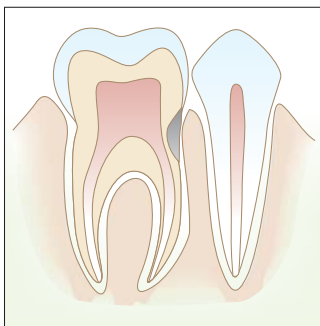


Figure 20.6: Root surface caries

Facial, Buccal and lingual Caries (Figure 20.7)

Facial, buccal and lingual caries occur in enamel pits and fissures of the teeth. When small they appear round, and as they enlarge they become elliptical or semilunar. It also shows sharp, well defined borders. It is difficult to differentiate buccal and lingual caries radiographically. When interpreting one should look for a uniform non-carious region of enamel surrounding the apparent radiolucency.

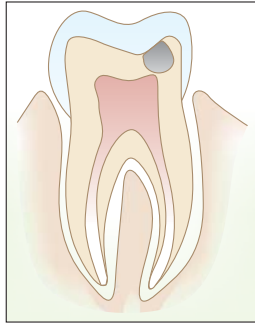


Figure 20.7: Buccal caries

Rampant Caries

This form of caries is commonly seen in children. They demonstrate extensive interproximal and smooth surface caries. Radiographs show advanced carious lesions especially in mandibular anterior teeth.

Radiation Caries

Radiation caries is seen in patients who have received therapeutic radiation to the head and neck. Radiographically it is characteristic of dark radiolucent shadows appearing at necks of teeth, most obvious on the mesial and distal aspects. Variations of depth of destruction may be present and generally they are uniform within a given region of the mouth.

RADIOGRAPHIC INTERPRETATION OF PERIODONTAL DISEASES

A healthy periodontium can be regarded as periodontal tissue exhibiting no evidence of disease. To evaluate the periodontium radiographs play an important role. Unfortunately radiographs provide retrospective evidence of the disease process. The pattern and degree of alveolar bone loss can be assessed in a radiograph.

Radiographs indicated in the assessment of periodontal diseases are:

- Intraoral periapical radiographs (Paralleling technique)
- Bitewing radiographs
- Panoramic radiographs

Radiographs are used to

- Assess the extent of bone loss and furcation involvement
- Assist in treatment planning
- To determine the presence of any secondary local destructive factors.

Healthy radiographic features of healthy tissues is when there is no evidence of bone loss. Bone loss is the difference between the present septal bone height and the assumed normal bone height for any particular patient, bearing in mind that the normal bone height varies with age. The only reliable radiographic feature is the relationship between the crestal bone margin and the cemento-enamel junction. If the distance is within the normal limits (2 to 3 mm) and there is no clinical evidence of loss of attachment, then it can be said there is no periodontitis.

Healthy alveolar bone in a radiograph can be seen as:

- Thin, smooth, evenly corticated margins of the interdental crestal bone in the posterior regions.
- Thin, even, pointed margins of the interdental crestal bone in the anterior regions. Cortication at the top of the crest is not always evident, mainly due to the small amount of bone between the teeth anteriorly
- Interdental crestal bone is continuous with the lamina dura of the adjacent teeth. The junction of the two forms a sharp angle.
- Thin even width of the mesial and distal periodontal ligament spaces.

The terms used to describe the various appearances of bone destruction are: (Figure 20.8)

- Horizontal bone loss
- Vertical bone loss
- Furcation involvement

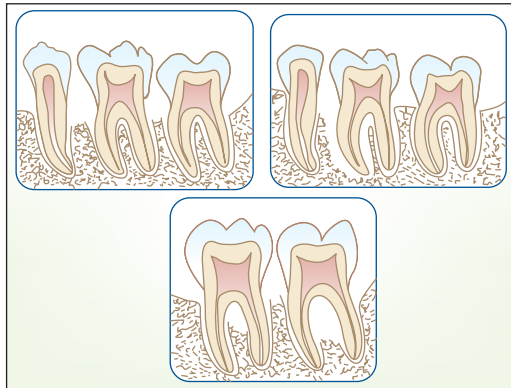


Figure 20.8: Patterns of bone destruction in periodontal diseases. (Horizontal, vertical and furcation bone loss)

The terms horizontal and vertical have been used to describe the directions or pattern of bone loss using the line joining two adjacent teeth at their cemento-enamel junctions as a line of reference. The amount of bone loss can be described as mild, moderate and severe. Severe bone loss, extending from the alveolar crest and involving the tooth apex, in which necrosis of pulp is also believed to be contributory factor, is described as an endo-perio lesion. The term furcation involvement is the term used to describe the radiographic appearance of bone loss in furcation area of the roots, which is an evidence of advanced disease in this zone.

Intraoral radiographs can be taken along with a radiopaque mesh grid, which helps in assessing the exact amount of bone loss. However paralleling technique should be used along with the radiopaque mesh (Figure 20.9).

Resorption of the alveolar bone is the main radiographic feature of chronic periodontitis. These include:

- *Loss of the corticated interdental crestal margin, the bone edge becomes irregular or blunted*
- *Widening of the periodontal ligament space at the crestal margin*

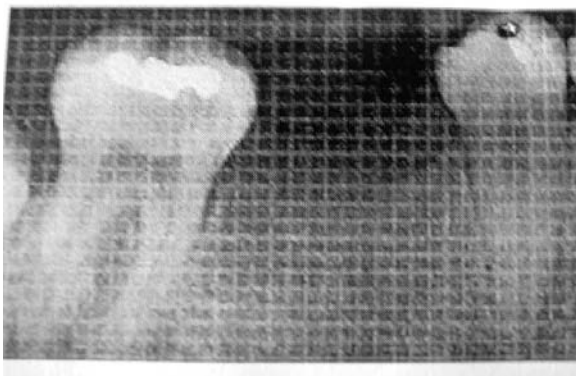


Figure 20.9: Photograph of mesh grid for estimation of bone loss

- *Loss of abnormal sharp angle between the crestal bone and the lamina dura. The bone angle becomes rounded and irregular*
- *Localized or generalized loss of the supporting alveolar bone*
- *Patterns of bone loss of the alveolar bone (horizontal or vertical) resulting in an even loss of bone or the formation of complex intra bony defects.*
- *Loss of bone in the furcation areas of multirooted teeth. This can vary from widening of the furcation periodontal ligament to large zones of bone destruction.*
- *Widening of interdental ligament spaces*
- *Association with secondary local factors like calculus deposits, carious lesions, overhanging filling ledges, poor restoration margins, lack of contact points, poor restoration contour, perforations by pins and posts, overerupted opposing teeth, tilted teeth, root approximation, endodontic status in relation to perio-endo lesions and gingivally fitting partial dentures.*



Specialised Imaging Techniques

Over the past few decades many new techniques of imaging the orofacial region have been developed. Imaging with other forms of energy such as radiofrequency emission (magnetic resonance), sound (ultrasound), heat (thermography), internal source radiation (scintigraphy) radiovisiography and contrast radiography have expanded our imaging capabilities.

COMPUTED TOMOGRAPHY (CT)

It is also referred to as Computed Axial Tomography, Computed Tomographic Scanning, Axial Tomography and Computerized Transaxial Tomography.

Godfrey Hounsfield and Alan Cormack were instrumental in the development of CT and were awarded the Nobel Prize in medicine in the year 1979 for their efforts. This radiographic technique blends the principles of thin layer radiography (tomography) with the use of a computer to synthesize the image (computed).

Working Principle

The computed tomographic image is initiated by a process called scanning. Beams from one or several small x-ray sources are passed through the body and intercepted by one or more radiation detectors. These radiation detectors produce electrical impulses that are proportional to the intensity of the X-ray beam emerging from the body.

The intensity of the x-ray beam exiting the body is determined by

- a. The energy of the x-ray source
- b. The distance between the source of x-rays and the detector
- c. The attenuation of the beam by materials in the object being scanned.

Although a single source and a single detector array can produce a single scan, the efficiency of the scanning system can be increased multiple fold by using multiple x-ray beams and equivalent number of detectors. Each scan produces a penetration or absorption profile. However construction of the image requires profiles obtained at different angles through the patient under study. The X-ray source and detector assembly are rotated around the patient (360°) to produce multiple profiles of the particular site of interest.

The X-ray beam attenuation is collected in a grid like pattern called matrix. Each square in the matrix is made up of a pixel (picture element), which represents the x-ray attenuation of a small finite volume of tissue called voxel (volume element). The typical image matrix for most CT scanners is 512×512 pixels (Figure 21.1).

Each pixel represents a calculation of the actual attenuation of the x-ray beam by constituents within the body. A number (CT number or Hounsfield unit) is designated for each pixel corresponding to the degree of beam attenuation. The CT numbers generally range from +1000 to -1000. By convention, water is designated the number 0. However, some scanners may differentiate between CT numbers that range from -2000 to +6000, but most monitors may display only 256 gray scales and the human eye can perceive only 64 shades of gray.

CT Numbers for Commonly Imaged Tissues

Tissue	CT number
Air	-1000
Lung	-200
Fat	-100

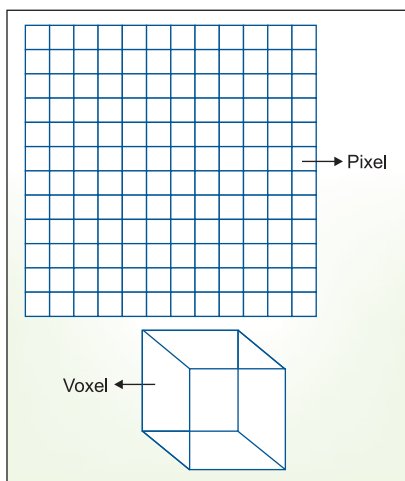


Figure 21.1: Pixel and Voxel

Water	0
CSF	+15
Blood	+20
Gray matter	+40
White matter	+45
Muscle	+50
Medullary bone	+300
Cortical bone	+1000

Since the CT numbers represent attenuation or density, the computer constructs an image by printing the numbers or by assigning different shades of gray to each number thereby transforming a string of numbers into an image.

Computed Tomographic Scanner Assembly

Though CT scanners are available in different system configurations, they all have the same basic components:

1. Gantry
2. Patient support couch



3. Computer
4. Operating console

Gantry

The gantry is made up of the detector array, patient support couch, and the x-ray tube or source. The gantry can be tilted up to 30°. The facility to tilt helps in excluding structures from the scan that may degrade the final image (for example metallic dental restorations).

Detector array: The detector is made up of multiple discrete cells or detectors. Each of these detectors acquires specific information for each slice of the scan and transmits it to the computer. The present fourth generation CT scanners have up to 2400 detectors.

The detectors contain either a crystal scintillation detector or a gas-filled detector. Commonly used scintillation detectors are manufactured with cesium iodide (CsI), bismuth germanate or cadmium tungstate (CdWO_4). These solid-state detectors are coupled optically to a photodiode. Solid-state detectors exhibit detection efficiency that approaches 100% but cannot be packed closely together. Gas-filled detectors contain either xenon or a xenon-krypton mixture. These gases have a high atomic number, are inert, and display minimal afterglow. The gas is contained under high pressure in the detector array. The individual gas-filled detectors can be placed closely together; the gas, however, in the detector only produces approximately 50% detector efficiency. Regardless of the material used to capture information, the spacing of each discrete detector coupled with their detection efficiency determines the efficiency of the scanner and the ultimate spatial resolution.

X-ray source: The x-ray source for the currently available scanners consists of an x-ray generator and an x-ray tube. The x-ray generator is designed to produce a high mA (up to 400 mA) beam at a nearly continuous rate. The large amount of heat generated through continuous beam production necessitates the use of a large rotating anode and fairly large focal spot.

The x-ray beam is collimated before it traverses through the patient (pre patient collimation) and at the detector array (post patient collimation). The pre patient collimation decreases the radiation dose to the patient. The post patient collimation reduces the amount of scattered radiation that contacts the detector array, thus improving CT image quality.

Patient Support Couch

The patient support couch helps in stabilizing the position of a patient during a CT scan. The couch must be made of a low-molecular-weight material such as carbon fiber to ensure that the path of the x-ray beam is not altered before or after it traverses the patient. The couch is motorized so that the movement of the patient for slice acquisition is smooth, controlled and reproducible. The angle of the patient couch can be altered to capture images in different planes. The angulation of the patient is reported as “tilt” on the print out of the image.

Computer

The rapidity of capturing the image, acquiring data, and larger matrix size (512 x 512) necessitates the use of high-speed computers.

Modern CT scans require computers that can solve up to 30,000 equations simultaneously. The time it takes the computer to generate a visible image after data acquisition is termed “reconstruction time.” Reconstruction time for a single slice is usually about one second. These computers can constitute up to one third the cost of a CT scanner.

Control Console

The control console allows the operator to select the parameters of the CT scan and view the image as they are being generated. Many consoles have two monitors so that the technician and the radiologist can manipulate the image as the data is acquired. Image data is stored into the computer so that it can be

formatted later into a number of ways. Data is stored either on magnetic tapes or disks. Most CT images are viewed on a film. The electronic data from each view is transferred on to a film using laser cameras. The most common film format is 14 × 17 inches and may contain 4 to 15 images.

Advantages of Computed Tomography

1. Multiplanar imaging—Image acquisition in cross sectional or in other planes
2. Greater geometric precision—CT solves the problem of superimposition by allowing the clinician to view a series of thin sections (1.5-10 mm) thick depending on the anatomic site.
3. Manipulation of the acquired image—The radiographic contrast and brightness can be adjusted based on the requirement.
4. Soft tissue imaging—Helps in separating subtle tissue contrast differences (as low as 0.5%).
5. Helps in distinguishing objects of subtle differences in density such as between blood and fat, blood and CSF

Disadvantages of Computed Tomography

1. Expensive
2. Patient's exposure to radiation—CT is considered a high radiation dose technique (depends upon region imaged, number of slices, thickness of slice and kVp). For a head scan the effective dose has been calculated as 2 to 4 mSv and 5 to 15 mSv for a body scan. A mid skull dose for a Postero Anterior view (PA skull) or Townes view is about 3-5 mgy, where as a mid skull dose of about 34-55 mgy is seen with a CT.
3. Production of artifacts, especially when metallic restorations are located in the plane of tissue being scanned. These streak type artifacts may obscure radiographic findings in the CT scan and render it useless for diagnosis.

Uses of CT in Dentistry

1. Evaluation of the presence and extent of clinically suspected pathology in the head and neck region including cysts, tumors and infections.
2. Detection of the extension of disease process into the para nasal sinuses, base of skull, and orbit.
3. Determination of the location, extent and displacement of maxillofacial skeletal fractures, including detection of subdural and epidural hematomas.
4. Salivary gland imaging
5. Evaluation of potential implant sites using 3D image reconstruction
6. Evaluation of the components of the temporomandibular joint
7. CT guided fine needle aspiration biopsies
8. Virtual surgeries

MAGNETIC RESONANCE IMAGING (MRI)

Magnetic resonance imaging provides anatomic and physiologic information non-invasively and without the use of ionizing radiation. MRI makes use of non ionizing radiation from the radio frequency band of the electromagnetic spectrum.

Lanterbur in 1973 published the first cross sectional images of objects with magnetic resonance techniques.

Working Principle

MRI depends upon the properties of the nucleus. Many, but not all nuclei, have magnetic properties and they behave like tiny magnets.

Normally the magnetic nuclei are haphazardly oriented. But if these nuclei are placed into a strong and uniform magnetic field they line up with the direction of the magnetic field and rotate about the direction of the magnetic field like spinning tops. When a specific radiowave is applied they spin faster than before. But if the radiowave is removed they release the absorbed energy in the form of radio waves and the nuclei relax (Figure 21.2).

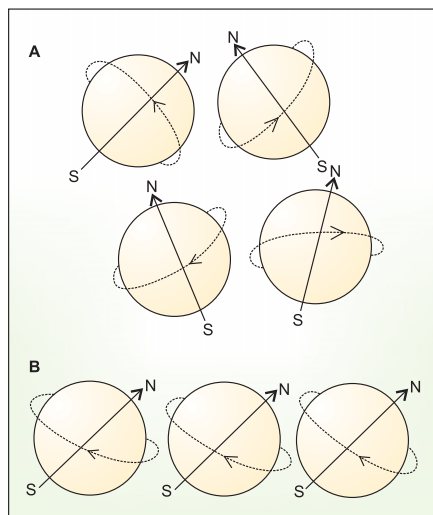


Figure 21.2: Spin of hydrogen atom

A radiowave is transmitted by the nucleus that represents the Magnetic Resonance signal. This MR signal can be picked up by a sensitive antenna, amplified and processed by a computer to produce an image. Hydrogen is chosen as the element for MRI because it is found in large quantities in the body in the form of water and it is a highly sensitive to MR signal.

MRI Assembly

The Magnetic resonance scanner is a cylindrical device into which the patient, lying on a specially designed table is placed. The scanner surrounds the patients body with powerful electromagnets. A cooling system removes the heat generated by the electromagnets. These electromagnets create an extremely strong external magnetic field (1-1.5 Tesla) that causes the randomly oriented spinning nuclei of hydrogen atoms in the patient's body to align. This state is now intentionally disrupted when a radiofrequency pulse is applied which knocks the nuclei of hydrogen atom out of alignment.

These disrupted nuclei re-arrange themselves within milliseconds and emit distinctive radiofrequency signals, which are stored in a computer.

Factors that affect the MR signal

1. Density of the nucleus of the hydrogen atom
2. Relaxation time
3. Flow phenomenon

Density of the Nucleus of the Hydrogen Atom

Signal strength depends on the number of processing nuclei in a given volume of tissue

Greater the number of hydrogen atom nuclei per unit volume of tissue, greater and stronger is the MR signal

Relaxation Time

There are two processes by which the excited nuclei relax

- a. *Longitudinal relaxation time or Spin lattice relaxation (T1)*

When the nuclei release their excess energy to the general environment, it is called spin lattice relaxation time or T1

- b. *Transverse relaxation time or Spin -Spin relaxation (T2)*

Release of energy by the excited nuclei through interaction among themselves. The rate of this process is called T2 relaxation time.

Short T1- Intense signal, displayed as white

Long T1- low intensity signal, displayed dark

Short T2- low intensity, dark image

Long T2- High intensity signal, bright image

Flow Phenomenon

Moving substances give a weak MR signal. Flowing blood in vessels has a low signal. Where as stagnant blood as in acute blood clots have higher intensity MR signal. Thus MRI can be used to determine the vessel patency or rate of blood flow through vessels.

Appearances of various tissues in T1 and T2 weighted images

Tissue	T1 image	T2 image
Water	Dark	Very bright
Fat	Very bright	Bright
Fibrous tissue	Dark	Dark
Organs	Intermediate	Dark
Tumors	Intermediate	Bright
Fresh blood	Dark	Dark
Old blood	Bright	Bright
Air	Dark	Dark
Bone calcium	Dark	Dark

Uses of MRI in Dentistry

1. *Use of MRI for head and neck lesions:* T1 weighted images are useful for defining the anatomy of the lesion
T2 weighted images are useful for assessing invasion of the lesion into surrounding structures.
Extension of the lesion into muscles, brain or blood vessels can be precisely studied using contrast enhanced MRI.
Coronal scan helps in the assessment of lesions involving the base of the skull and the perineural extensions of tumors.
2. *Congenital disorders:* T1 weighted sequences with coronal and axial images demonstrate abnormalities such as cleft lip and palate.
3. *Infections:* AIDS- Generalized cervical lymphadenopathy with cystic lesions in the parotid can be demonstrated in an MRI
4. *Sinusitis:* MRI of the sinus is indicated only when sinusitis is complicated by a serious condition like a tumor, venous sinus thrombosis or an intracranial extension of the infection.
5. *Benign Tumors:* Hemangiomas, Lymphangiomas, Neurofibromas and Schwannomas can be studied.
6. *Malignant tumors:* MRI can be used for the diagnosis, staging and for the monitoring of malignant tumors affecting the head and neck region.

7. *TMJ*: It is the best imaging technique to study the TMJ (articular disc perforations and disc displacements can be evaluated on a MRI.)

Advantages of MRI

1. Offers best resolution of tissues with low inherent contrast
2. MRI uses non-ionizing radiation and hence considered non-hazardous
3. Accurate and rapid localization of intracranial pathologies
4. No streaking artifacts as in CT
5. High contrast images are achievable in MRI

Safety Concerns/Disadvantages

Human tissues are diamagnetic, that is, they are not susceptible to magnetic fields.

1. Some patients may complain of mild pain or tingling sensation (seen in echo planar imaging technique)
2. Routine use of earplugs or headphones is advocated during MR imaging as the noise produced during the procedure may prove uncomfortable to some patients. (Noise is produced as a result of rapid alterations of current in the gradient coils)
3. MRI is contraindicated in patients with cardiac pacemakers (may be adversely affected by the magnetic field)
4. MRI is not used in patients with ferromagnetic substances implanted in their body such as intracranial aneurysmal clips)
5. Other disadvantages of this imaging technique are its cost and availability
6. The room used for imaging should be free of ferromagnetic materials such as scissors, stethoscopes, and clip boards as these can turn out to be potential projectiles that may injure patients and health care providers.

CONTRAST RADIOGRAPHY

In the conventional methods of radiography the image is formed as a result of differential attenuation of the x-ray beam as it

passes through structures. It is a known fact that structures that lack sufficient density fail to attenuate the beam enough to show on a radiograph. However when the density of the structure of interest is low to be visualized or if the object contrast is too low to meet the specific diagnostic needs, the contrast and density can be improved artificially.

Types of Contrast Media

Contrast media are broadly classified into two categories:

- I. Based on the density
 1. Low density contrast media
 2. High density contrast media
- II. Based on solubility
 1. Water soluble contrast media
 2. Fat soluble contrast media

Low Density Contrast Media

Gases like air, oxygen and carbon dioxide can be used on their own to outline internal organs, but these agents have been largely replaced by modern radiographic techniques such as ultrasonography and Computed Tomography.

High Density Contrast Media

These are also referred to as positive contrast agents. Barium and Iodine are commonly used as positive contrast agents. Barium is used specially for investigative procedures involving the gastrointestinal tract.

Iodine preparations are used in the investigative procedures involving the kidney, gallbladder, cardiovascular system, lymphatic system, spinal cord and in dentistry.

Water Soluble Contrast Media

These agents produce a less definite radiopaque image when compared to the oil contrast media

They diffuse readily into any residual cyst fluid and cause its opacification well before it diffuses into the cyst wall.

Readily soluble compared to oil soluble media
They cause very little discomfort to the patient during the process of sialography and sinography
Examples: Isopaque75, Diodrast and Sinografin

Oil Soluble Contrast Media

Generally viscous in nature since they are viscous they need to be injected slowly and with some amount of pressure.
Needles with wide bores are preferred
Oil media are retained in the tissues for a longer period compared to water soluble media
Examples: Lipiodol, Ethiodol, Pantopaque and Dionosil

Contrast Radiographic Procedures

1. Sialography
2. Arthrography
3. Cystography
4. Pulpography
5. Arteriography
6. Sinogram
7. Nasopharyngography

Sialography

Sialography is the retrograde injection of an iodinated contrast agent into the ductal system of a salivary gland. In 1925 Barsony introduced the technique of injecting a radiopaque medium (20% potassium iodide) into the ductal system of salivary glands.

Indications

1. Detection or confirmation of small parotid or submandibular gland sialoliths or foreign bodies
2. Evaluation of the extent of irreversible ductal damage present as a result of chronic infection.
3. Differentiating between diseases such as chronic sialadenitis, Sjögren's syndrome and sialosis
4. Evaluation of fistulae, strictures, diverticula, communicating cysts and ductal trauma



5. Rarely, as a dilating procedure for mild ductal stenosis
6. Evaluation of masses within the submandibular or parotid salivary gland in conjunction with a CT scan.

Procedure

1. *Armamentarium*: Sialographic cannulas (Rabinov cannulas, cannulas designed by Lowman and Bezella)
A set of lacrimal dilators (0000 through 0 calibre)
Iodinated contrast agent
5 ml or 10 ml syringe
Gauze pads
Secretagogue to stimulate salivary flow such as fresh lemon, or 2% citric acid
Adequately focused lighting, a head light unit
High powered magnifying glass
2. *Pre imaging assessment*
 - i. Patient should be asked about history of allergy to iodine/contrast agents
 - ii. Medical history about medications
 - iii. Previous salivary diagnostic tests and the results of the same
 - iv. Ask the patient whether any thyroid function tests are scheduled in the near future (absorption of iodine across glandular mucosa may interfere with thyroid function tests, in such a case it is recommended that the sialography be deferred after the thyroid tests have been performed)
 - v. Examine the ductal orifice, if purulent discharge is evident the procedure should be deferred until the condition has resolved.
3. *Preimaging instructions to the patient*
 - i. Explain the procedure to the patient
 - ii. Patient is told to expect a sense of fullness or pressure within the gland during the procedure
 - iii. The patient should be instructed to indicate to the examiner by means of a predetermined signal, when the injection of the contrast agent is becoming uncomfortable (this is the accepted end point for injecting the contrast agent)

- iv. Patient should be informed to expect a mild amount of discomfort and swelling of the gland in question, which usually subsides in 24 to 48 hours.

Technique

1. Patient is made to lie down in the supine position.
2. Scout radiographs, comprising Posteroanterior (PA) view, PA puff cheeked view and lateral views are taken for the Parotid gland and for the submandibular gland; AP view, lateral oblique view and a submentovertex view are taken. The scout radiographs are taken for two reasons. To evaluate for any large calcifications within the salivary glands and they form as base radiographs against which the sialograph can be compared.
3. The salivary duct orifice is located
4. Lacrimal dilators are used to dilate the salivary duct orifice
5. Cannulas are gently maneuvered into the orifice to locate the salivary duct. At this stage, asking the patient to suck on freshly cut lemon will produce saliva aiding in locating the duct orifice
6. Contrast medium is injected into the salivary duct.

Contrast medium can be injected by three techniques

- a. Hydrostatic injection technique
- b. Distension injection technique
- c. Hand injection

Hydrostatic injection technique: In this technique a reservoir is used which contains the contrast media. This reservoir is placed about 70 cm above the patient's head. This arrangement permits the constant perfusion of the ductal system with a water-soluble contrast agent. This system provides for a uniform pressure during injection without the examiner being physically present in the room. This technique is useful in CT guided sialography.

Distension injection technique: Distension sialography involves the hand injection of the contrast media until the gland physically

bulges. This usually requires 2.5 to 3 ml of the contrast media. (In normal cases where routine hand injections are used 0.5 to 0.75 ml is used). This technique was popular in the pre CT era to evaluate and visualize small peripheral masses within the duct or the gland. This technique is not preferred any more.

Hand injection: This is the most preferred technique for injecting the contrast media into the gland. The contrast media is injected gently using a steady constant pressure. The injection is performed under fluoroscopic observation and stopped immediately when the patient indicates that the injection is becoming uncomfortable. Normally the parotid can accommodate 0.5 to 0.75 ml of the contrast media and the submandibular gland can accommodate about 0.5 ml of the agent.

The filling of the salivary duct and the gland can either be examined under fluoroscopy in real time or routine radiographs can be taken after the contrast media is injected.

Phases of Sialography (Figure 21.3)

1. Ductal Phase
2. Acinar Phase
3. Evacuation Phase

Ductal phase: The ductal phase begins with the injection of the contrast medium and terminates once the parenchyma becomes hazy (reflects the onset of acinar opacification).

The ductal phase of the normal parotid sialogram should demonstrate the main duct to be of uniform caliber extending from the ductal orifice to the hilus of the gland. The intraglandular portion of the parotid ductal system should demonstrate a progressive arborization of the secondary and tertiary ducts. This configuration is often described as a “leafless tree” appearance on a sialogram.

The ductal phase of the submandibular sialogram can be divided into two sub stages.

The first substage involves the filling of the deep portion of the main duct; the second sub stage involves the filling of the



Figure 21.3: Photograph showing a sialogram of submandibular salivary gland

superficial segment perpendicular to the mylohyoid muscle as well as the remainder of the ductal system. In contrast to the orderly arborization seen in the parotid duct, the submandibular ducts are often noted to terminate abruptly with poor or incomplete filling of the tertiary elements.

Acinar phase: The acinar phase begins with the completion of ductal opacification and ends when there is a generalized increase in density of the gland. This phase was of special importance in the pre CT era, when sialography was intended to demonstrate the presence of intraglandular and extraglandular masses.

Evacuation phase: The evacuation phase of a sialogram provides an estimate of the secretory function of the salivary gland as well as demonstrating or accentuating ductal pathology that might not have been evident on other views.

The evacuation phase is divided into two sub phases:

- a. Nonstimulated evacuation of the gland and ductal system
- b. Stimulated evacuation of the gland and ductal system

The evacuation phase evaluated under intermittent fluoroscopy for about one minute, while checking for spontaneous clearing of the contrast agent from the gland. A normally functioning, unobstructed gland should be able to clear nearly the entire contrast agent.

The second subphase is an evaluation of the glandular response to stimulation using a sialogogue such as freshly cut lemon or 2% citric acid placed on the tongue and intermittently monitoring the clearing of the contrast from the gland fluoroscopically. The second sub-phase is performed if a significant amount of contrast is still present in the ductal system after the first subphase. The non clearing or partial clearing of the gland may be due to a stricture, a sialolith or both or an underlying physiologic abnormality.

Post stimulation views of the gland may demonstrate adequate clearing of the ductal system and intraparenchymal collections of contrast. Small 1-3 mm uniformly distributed collections of contrast agent may be seen as a result of pseudo sialectases. Where as, irregularly distributed or larger collections can result from abscess formation or tumor necrosis.

Contraindications of sialography

1. Acute salivary gland infections or patients recovering from acute infections
2. Malignant lesions involving the salivary gland
3. Patient is allergic to contrast agent
4. Patients who have to undergo thyroid function tests during the period of sialography
5. Pregnancy (High doses of radiation is used) especially for fluoroscopy.

Arthrography

Dr Fleming Norgaard was the first to successfully apply positive contrast arthrography to the TMJ in 1947, but it was not until the 1970's that Wilkes and others resurrected the technique in the United States.

Arthrography involves injection of a radiopaque contrast material into the joint spaces. The space occupied by the disc can then be visualized lying between the layers of contrast material.

Types of Arthrography

1. Single contrast arthrography
2. Double contrast arthrography

One of the more commonly used approaches involves injection of contrast material into the lower joint spaces, referred to as *lower joint space or single contrast arthrography*. Perforations of the disc or posterior attachment are demonstrated by contrast material simultaneously flowing into the upper joint space as the lower space is injected.

Another variation of the technique involves injecting contrast material into both the spaces and viewing the more central portions of the joint with tomography. Because contrast material is in both the joint spaces, the outline of the disc is profiled, showing its configuration and position. The outline of the disc can often be enhanced by using double-contrast arthrography. This technique involves injecting a small amount of air along with a small amount of contrast material into both joint spaces, producing a thin coat around the periphery of both joint spaces that highlights the disc and the joint spaces.

Advantages

1. Arthrography provides information regarding the soft tissue components, specifically the shape and position of the articular disc. It has been demonstrated that with the addition of tomography, the diagnosis of abnormalities in the position and shape of the disc is accurate.
2. Fluoroscopic observation of the injection may reveal the presence of adhesions, perforations and discontinuities in the capsule and provides a dynamic study of disc movements, also any abnormal accumulation of joint fluid may be evident.
3. Synovial fluid sampling (arthrocentesis) and lavage of the joint can accompany the procedure of arthrography.
4. Arthrography assures a correct pre-operative diagnosis of loose bodies (joint mice).
5. An arthrogram can clearly distinguish the synovial changes of an inflammatory arthritis from an internal derangement resulting from meniscal dysfunction.

Procedure

1. The patient is placed on the fluoroscopic table in a lateral recumbent position with the head tilted on the tabletop. This allows the joint to project over the skull above the facial bones in a manner similar to a transcranial radiograph.
2. Under fluoroscopic guidance the posterosuperior aspect of the mandibular condyle is identified with a metal marker. This area is marked with an indelible pen. Local anesthetic lidocaine is infiltrated into the superficial skin.
3. A 0.75 or 1 inch scalp vein needle and the attached tubing is filled with contrast material, taking care to eliminate air bubbles. Air bubbles may simulate bodies within the joint space.
4. In a direction perpendicular to the skin and X-ray beam, the 23-gauge needle is introduced in a predetermined region of the condyle with the jaw in the closed position. Advancement of the needle is done under fluoroscopic observation to ensure proper positioning.
5. When the condyle is encountered, the patient is instructed to open the jaw very slightly, and the needle is guided by feel of the posterior slope of the bony condylar margin. On fluoroscopic observation the needle will appear contiguous with the posterior condylar outline.
6. Approximately 0.4-0.5 ml of contrast material is injected into the lower joint compartment under fluoroscopic guidance. If the contrast is successfully placed into the lower joint space, the opaque material will be seen flowing freely anterior to the condyle in the anterior recess of the lower joint compartment.
7. The needle is then withdrawn and fluoroscopic videotape images are recorded during opening and closing maneuvers of the jaws.
8. Spot radiographs are obtained during the fluoroscopic procedure.

Limitations

1. Direct medial or lateral displacements are difficult to interpret with arthrography.
2. Cannot be used when the disc is severely deformed.

Complications

1. The rare serious complications associated with arthrography include joint sepsis, allergic reaction to the iodinated contrast medium and haemarthrosis.
2. Pain during and after the procedure, extravasation of the contrast medium, disc perforation and transient facial paralysis are less serious complications of arthrography.
3. The radiation exposure to the patient can be significant, depending on the duration of fluoroscopy and the number of tomographic exposures made.
4. The most frequent complication of the technique is the extravasation of contrast medium into the capsule and soft tissues around the joint, causing pain. Nonionic contrast media will be the agents of choice to minimize this discomfort.
5. Parotitis has been reported following arthrography with large needles and cannulas.
6. Some patients experience a vagal reaction, as a result of increased anxiety during the procedure, this can be managed by administering 0.6 mg of Atropine intravenously.
7. Intravasation of contrast material infrequently occurs. Epinephrine in a dose of 0.03 ml (1:1000) per 3 ml of contrast material is recommended because there is a risk of an acute hypotensive episode with intravasation of higher doses.
8. Transient facial paralysis may result from a rapid infiltration of lidocaine. Some patients experience a moderate degree of pain as the needle is placed on the periosteum of the condyle and as the joint is distended with contrast material. This discomfort is transient in majority of the cases. If persistent joint pain occurs following the procedure, aspirin or acetaminophen and cold compress application to the affected side is recommended.

Pulpography

Refers to the injection of contrast media such as Renograffin-76 (aqueous solution of organic compounds containing 370

mg/ ml of organic bound Iodine) into the pulp chamber and canals. Endodontic file used for the measurement of the root canal length is also an example of contrast radiography.

Uses of Pulpography

To evaluate pulp canal morphology

To evaluate for evidence of secondary/accessory canals

Evaluation of perforations of the root

Sinogram

Sinus or fistulous tracts can be outlined by contrast injections into the skin or mucosal openings and must be radiographed in two planes at right angles to each other to show their true position.

Previously lipidol was used but these days water soluble contrast agents are preferred. The contrast medium is injected through a sterile catheter inserted into the sinus or fistula, which must make a tight connection with the opening to prevent leakage of the contrast media into the surrounding structures. The contrast medium should be injected with some pressure to fill the entire length of the sinus or fistula. Radiographs are taken in the frontal and lateral projection with a surface marker on the opening of the orifice of the sinus or fistula.

An alternate technique is to insert guttapercha points of appropriate thickness into the sinus opening and then take a radiograph. The radiograph will reveal the radiodense guttapercha within the sinus or fistulous tract.

Nasopharyngography

In patients in whom clinical examination of the posterior nares or nasopharynx is difficult or in patients in whom clinical examination does not reveal any disease process but there is a strong clinical suspicion of a disease process, it may be useful to outline the nares and nasopharynx with contrast media.

The patient is asked to use an anesthetic gargle and the nostrils are anesthetized with 4% lignocaine spray. The patient lies supine with the head extended in the position for submentovertex radiographic position. Aqueous Dionosil contrast agent is instilled into each nostril, about 10 ml into each nostril. Submentovertex and lateral projections are taken to evaluate the nasopharynx.

Arteriography

Emergency arteriography is a useful diagnostic adjunct to rule out or demonstrate a suspected concomitant vascular injury in maxillo facial trauma. Once the contrast medium is injected, Townes and lateral skull projections are taken to evaluate for vascular injuries.

If the vascular injury is evident in the procedure surgical exploration and management can be accurately planned and executed.

Relative Contraindications

Uncontrolled blood pressure, severe anemia, neuralgias and cardio-vascular abnormalities.

Arteriography is contraindicated in patients with a marked atheromatous irregularity at the origin of the carotid or vertebral arteries because of the possibility of dislodging thrombus during catheterization.

Cystography

Cystography is used to study the extent and nature of cysts.

Procedure

1. The material contained in the cyst to be studied should be fully emptied in order to facilitate complete filling of the cyst with the contrast medium.
2. Aspiration of the cyst can be achieved by using two needles (21 Gauge) or a single injection double-barreled Totter

needle. One needle is meant for passage of air and the other for aspiration.

3. The contrast medium is injected and the patient's head is moved in such a way that facilitates the flow of the contrast medium into all parts of the cyst cavity.
4. This can be achieved by asking the patient to first sit up right, then supine and later into lateral positions.
5. Care should be taken while injecting the contrast media into the cavity; it should be ensured that the contrast medium does not escape into the surrounding mucosa.

Disadvantages

1. Contrast media may leak around the needle allowing the material to be introduced between the cyst and adjacent tissues.
2. Overfilling of the cyst may lead to rupture of the cyst lining.

DIGITAL RADIOGRAPHY

Recent advances in imaging have focused on the replacement of film based technology with computer based devices that use electronic or storage phosphor receptors to record the radiographic image in a digital format.

Advantages

1. Digital systems do not rely on chemical processing of the image. This eliminates the need for a dark room, processing tanks and solutions. The inconvenience and errors associated with film processing in the conventional method are eliminated.
2. The radiographic image can be viewed immediately.
3. Environmental hazards resulting from the use of chemicals in the processing can be minimized.
4. The properties of the acquired image can be manipulated as per the requirement as the image is in the digital format.

5. The cost and time of storing and retrieving digital images is considerably lower
6. Higher efficiency of electronic sensors in comparison to conventional films makes it possible to reduce the radiation exposure to the patient.

RADIO ISOTOPE IMAGING

Nuclear Medicine

Nuclear medicine is a diagnostic radiation science utilizing radioactive compounds having affinities for particular tissues in the body; these are termed as target tissues.

The radioactive agents are administered to the patient either orally, intravenous or intrathecally. These agents concentrate in target tissues. These are detected and imaged by a variety of external detectors and imaging systems. This helps in studying the target tissue under static and dynamic conditions. Such studies are called scintigraphic scans or radionuclide scans. When these are performed on bone they are referred to as bone scans and when performed for salivary gland they are termed as salivary gland scans.

Scintiscans

They are two dimensional representation of the gamma rays emitted by a radioactive isotope, revealing its concentration in a specific organ or tissues. Scintillation basically refers to emission of charged particles.

History

The rectilinear nuclear scanner was first used in 1951. This device moved back and forth over the organ to be imaged, generating a picture of the organ based on the amount of radioactivity of the organ. In 1958 Hal Angler used scintillation camera for imaging the entire system. In 1971 Subramanian, McFee used ^{99m}Tc (Technetium) labeled MDP (Methylene Diphosphonate) in bone scanning (Figure 21.4).

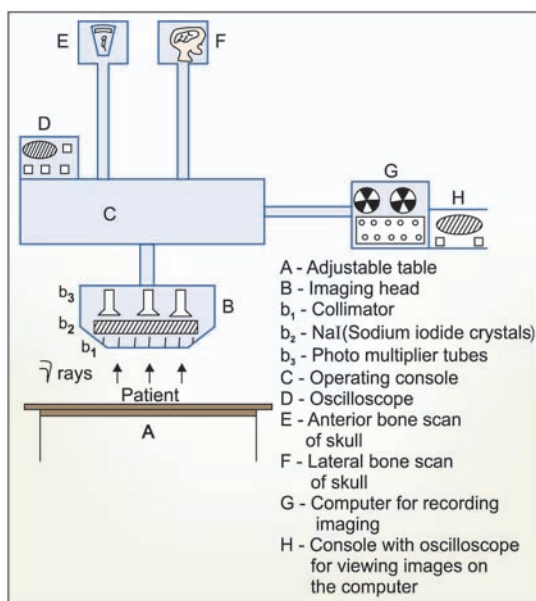


Figure 21.4: Bone scan

Radiopharmaceuticals

The radioactive compounds used in nuclear medicine procedures for imaging are referred to as radio pharmaceuticals.

Classification

These may be divided into:

1. Radioactive elements/compounds

^{99m}Tc , ^{18}F , ^{131}I

2. Non-radioactive carrier compound with a radioisotope

^{67}Ga labeled citrate

^{125}I labeled polyphosphate

Tc labeled human serum albumin

These radioactive elements or compounds are produced using nuclear reactors, cyclotrons or other generators.

The form in which the agent is introduced into the patient is determined by the biologic characteristics of the organ to be studied.

For example:

1. Labeling various phosphate compounds with ^{99m}Tc results in the agents concentration in the skeleton hence this is used in a BONE SCAN

2. Labeling sulphur colloid with ^{99m}Tc gives an agent that is taken up by the reticulo endothelial cells of the liver and spleen, hence this used in LIVER-SPLEEN SCAN.

Technitium as a radiopharmaceutical (^{99m}Tc MDP—Technitium Methylene Disphosphate)

It is the most frequently used of all the radioisotopes

It is generator produced hence it is conveniently available and relatively inexpensive.

It has a short half life (6.5 hrs), hence there is minimal radiation exposure.

Is the agent of choice because of its superior physical and biological characteristics.

Principle

The regional uptake of the tracer is dependent on a few factors:

1. Changes in the regional blood flow
2. In sites of altered bone physiology and pathology which show an invariable alteration in the osteoblastic and osteoclastic activity.

MDP is localised in bone by chemiabsorption onto immature hydroxy apatite crystal within newly formed inorganic matrix and cannot be metabolised by the enzyme system.

Concepts of Hot/Cold Spots and Supercans

Abnormalities in bone are manifested in a scan mostly as:

1. As foci of increased tracer concentration—when lesions have both an osteoclastic and osteoblastic activity.

2. As photon deficient areas—when lesions are purely osteolytic without an osteoblastic response. Therefore areas of increased tracer uptake seen as HOT SPOTS and COLD SPOTS are areas of decreased tracer uptake.

Occasionally the entire skeleton will be diffusely hot with no other background activity, these are termed as SUPER SCANS.

Appearance of a Normal Scan

A normal scan shows a uniform and bilaterally symmetrical distribution of the tracer. The normal activity and uptake of the tracer varies according to:

1. Bone mass/density
2. Bone stress in weight bearing areas.
3. Normally some activity will be visualised in the background soft tissue as well as in the urinary tract.

Indications of Bone Scanning

1. Neoplasms—for early detection of skeletal metastasis from primaries elsewhere in the body
2. Inflammation—detection of osteomyelitis
3. Trauma—for the detection of recent fractures, delayed/non-union of fractures
4. To assess viability of a bone graft
5. Temporomandibular joint changes
6. Infective foci of tuberculosis

Procedure of Bone Scanning

The radioisotope is administered to the patient. These radioisotopes reach the desired organs and emit gamma radiation which are picked up by the detectors placed outside the body.

Gamma Cameras

These are devices to image the radioisotope distribution in the body, within the field of view. It consists of a sodium iodide

detector of about 40 cms in diameter. The detector assembly has a collimator which is similar to a grid in radiography. The gamma radiation emitted by the patient passes through the holes in the collimator and reaches the detector, where they are converted into light scintillation. The photo multiplier tubes convert the light into electric pulse which is then passed on to the computer. The computer constructs the distribution of the radioisotopes and displays it on the monitor.

No special patient preparation is required. The preparation of the radiopharmaceutical involves the elution of pertechnetate (^{99m}Tc 04) from the generator and the subsequent reaction of it with phosphate compound in the presence of tin. The phosphate acts as a carrier molecule of ^{99m}Tc . 10-15 millicuries of ^{99m}Tc labeled compound is injected IV. A waiting period of 2-3 hours, permits the compound to accumulate in the skeleton and to be removed from vascular and soft tissues via the urinary system. The patient is then positioned under the Gamma camera and various projections of the entire skeleton and individual bones are taken.

Applied Aspects

In interpreting bone scans of the skull and face care should be taken to avoid misinterpretation of activity in the mandible and maxillary alveolar ridges which are common sites of uptake due to:

- Dental infections
- Extraction sites
- ill fitting dentures

Detection of skeletal metastasis: Scintigraphic survey of the entire skeleton forms an essential investigation during the initial diagnostic work up of any malignancy, especially of those which have predilection for skeletal metastasis like carcinoma of breast, lung and kidney.

Normal radiographs require atleast 30-50% demineralization to result in any altered radiodensity.

Trauma: Absence of any uptake even 24-48 hrs after an injury excludes a fracture.

The ability to determine the age of the fracture using bone scans has medicolegal applications.

Viability of bone grafts: A nonvascularised bone graft, implying an unsuccessful graft shows as a *cold spot*.

A vascularised bone graft indicative of an osteoblastic activity, shows a *hot spot*.

TMJ changes: Subtle changes occurring in the adjacent bone due to local pathology or altered stress on the articular surfaces prior to gross morphological changes can be determined on a bone scan.

Osteomyelitis: Can be detected by radionuclide hyperactivity in the involved bone as early as 1-2 days after the onset of symptoms.

Metabolic bone diseases: Bone diseases such as osteomalacia, hyperparathyroidism, renal osteodystrophy, fluorosis can be evaluated using a bone scan.

Extraosseous localisation: ^{99m}Tc MDP apart from localising in the skeleton it also localises in several soft tissues lesions such as muscle injuries, myocardial infarct, primary breast lump and lung metastasis from osteosarcoma.

Radiobiologic Considerations

Radiopharmaceuticals circulate and concentrate to varying degrees in different organs throughout the body.

The critical organs (those organs which receive greatest exposure) in bone scanning are the bladder, skeleton and bone marrow.

There have been no reports of any side effects of the injected compound.

Unlike conventional radiography where in only the area to be examined is exposed to radiation, in bone scan the whole body is exposed to radioisotopes.

However the whole body radiation dose in bone scan is approximately 0.1 - 0.5 rad.

Digital Radiography

In digital radiography the conventional film is replaced by image receptor (sensors).

There are three receptor systems that are available:

- i. Charge-coupled device (CCD)
- ii. Storage phosphor (SP) systems
- iii. Complementary metal oxide semiconductor (CMOS)

Charge-coupled device

A CCD includes a sensor (Figure 21.5A) that is placed in the patient's mouth. A cable leads from the sensor to an interface, which is connected to a computer. The CCD also includes a pixel array (electron wells) on a silicon chip. After exposure, x-ray energy is converted to a proportional number of electrons, which are deposited in the electron wells, then transferred in a sequential manner to a read-out amplifier (charge coupling). This analog signal is converted to a digital signal by an analog to digital converter (ADC) and the x-ray image is visible almost instantaneously on the computer monitor (Figure 21.5B). The major drawback to CCD technology is that intraoral sensors are much thicker than film. The sensor may not be well tolerated by patients, so sensor placement may be difficult and more time-consuming compared with film. The cable attached to the sensor is easily damaged and may interfere with sensor placement. In addition, the entire surface of the sensor is not active, as some space is occupied by electronic components. As a result, the actual area available for image capture may be as little as 60% of the sensor area, although this varies with manufacturer and sensor size. The radiographic image will depict a proportionally smaller area than conventional film, occasionally resulting in the need for additional images to view the entire area of interest. Sensors are available in various sizes to simulate the different film sizes used clinically. A plastic cover is fitted over the sensor and part of the cable, as the sensor cannot be autoclaved or disinfected.

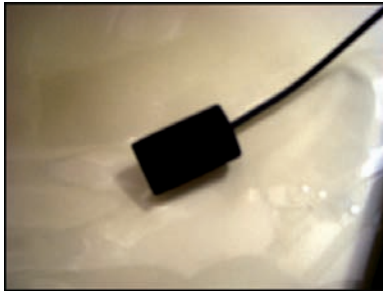


Figure 21.5A: Digital Sensor (CCD)



Figure 21.5B: Computer monitor for digital radiography

CMOS system

An alternative to CCD technology is complementary metal oxide semiconductor active pixel sensor (CMOSAPS) technology. These

sensors do not require charge transfer, resulting in increased sensor reliability and lifespan. In addition, they require less system power to operate and are less expensive to manufacture. Recently, wireless sensors have been introduced, eliminating the need for a cable attached to the sensor, but they may not be practical if there is electronic interference from external sources.

Storage phosphor (SP) system

An SP system uses plates comprising a flexible polyester base coated with a crystalline emulsion of europium activated barium fluorohalide compound. These plates are similar in size and thickness to conventional radiographic film and the entire surface area is active. The plate is placed in a plastic pouch, which is sealed, preventing contact with oral fluids. Incoming x-ray energy is stored in the emulsion and a latent image forms on the SP plate, analogous to the latent image that forms on a conventional film emulsion. The plate is removed from the patient's mouth, the plastic pouch is discarded and the plate is placed into a laser scanner, which acts as an electronic processor.

A laser beam scans the entire surface of the plate, and the stored electrons are released as visible light, which is recorded. This analog signal is converted to a digital image, which is viewed on a computer monitor. Depending on the size and number of plates placed in the laser scanner and the desired resolution of the images, it may take from about 20 seconds to several minutes for the image to appear on the computer monitor. Because not all the energy stored on the SP plate is released during scanning, the plate must be "erased" by exposing it to a strong light source for several minutes before it can be reused.

Ultrasonography

The human ear can detect sound in the frequency of 1500 to 20,000 cycles per second (Hertz). Sound waves traveling in the frequency greater than 20 kilo Hertz (kHz) are designated as ultrasound. In medical and dental diagnostic imaging, sound waves in the range of 1 to 20 mega Hertz (mHz) are used.



Working principle

The equipment used for ultrasonography is made up of two principal components, namely the scanner and the transducer. The scanner generates electrical impulses and the transducer converts these electrical impulses into sonic waves.

The transducer is made of Zirconate Titanate crystal (piezo electric crystal). When electric impulses from the scanner are applied to the crystal, due to realignment of the dipoles, the crystal changes its thickness thereby producing sonic vibration. These sonic vibrations are directed towards the target region in the body. The tissue interface reflects the ultrasound to produce echoes. The reflected echoes are picked up by the transducer and converted back to electrical signals.

These signals are displayed on the computer monitor as black, white and gray images. Doppler ultrasonography can be used to detect change in sound frequency from a moving source such as arterial or venous blood. Red and blue colors can be added to the echo picture image by the computer for easy identification of arterial and venous blood.

Indications

1. To assess the content and location of soft tissue tumors
2. To assess vascularity of soft tissue masses
3. To estimate the extent of fascial space infections
4. Evaluation of salivary gland tumors
5. Temporomandibular joint imaging
6. Assessment of blood flow in carotid and carotid body tumors
7. Ultrasound guided fine needle aspiration biopsy

Advantages

1. Widely available and inexpensive
2. No known harmful effects of ultrasound on the human body (non-ionizing radiation)
3. Can be used effectively to differentiate between different soft tissue masses

Limitations

No image is produced when the tissue absorbs ultrasonic waves. Therefore, this technique is not effective for imaging air filled cavities, bone and calcified structures as they all absorb ultrasound.

1. Cannot detect intrabony lesions
2. Cannot be used to evaluate paranasal sinuses
3. Poor image resolution

Thermography (thermal imaging or infrared imaging)

Thermography is a non-invasive diagnostic imaging procedure that detects, records, and produces an image (thermogram) of a patient's skin surface temperatures and/or thermal patterns. The procedure uses equipment that can provide both qualitative and quantitative information on the normal and abnormal functioning of the sensory and sympathetic nervous systems, vascular system, musculoskeletal system, and local inflammatory processes.

There are presently two recognised techniques of thermal imaging namely electronic infrared telethermography and liquid-crystal thermography.

Liquid Crystal Thermography (LCT): LCT utilizes a range of interchangeable “screens” impregnated with cholesteric methyl-ester derivatives that change color as a function of their temperature. The “screens” are placed on the anatomic surface for development. A 35 mm or polaroid picture of the image is taken for later analysis and archive.

Electronic Infrared Telethermography (IRT): IRT equipment incorporates single or multiple infrared detectors that survey the region to be studied in two directions simultaneously. The process does not involve contact with the surface of the skin.

Patient preparation

- a. The patient should be instructed not to use lotions, creams, powders, make up deodorants or antiperspirants on the body area to be imaged on the day of the examination.

- b. The body areas included in the image should not be shaved within four hours of the examination.
- c. No physical therapy, ultrasound treatment, acupuncture or hot/cold pack should be used 24 hours before the exam.
- d. No exercise 4 hours prior to the exam.
- e. Patient should not bathe for an hour prior to the exam
- f. The area to be imaged should remain completely uncovered of clothing or jewellery.

Procedural requirements

The room should be of adequate size to maintain an uniform temperature. A room approximately 8 feet by 10 feet is adequate to meet these requirements. During the examination, the patient should be positioned relatively equidistant and adequately spaced from each wall. The room should be carpeted. Curtains may be used to prevent outside infrared radiation from entering the room.

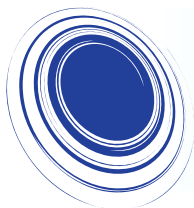
The room must be free from drafts. Windows and doors should be adequately sealed to prevent airflow in the area where the patient is positioned. Incandescent lighting should not be used during the examination due to the amount of infrared radiation produced. Standard fluorescent lighting is adequate.

The temperature range in the room should be maintained between 18 and 23 degrees C. Room temperature changes during the course of an examination must be gradual so that steady state physiology is maintained and all parts of the body can adjust uniformly. The temperature of the room should not vary more than one degree celsius during the course of a study. The humidity of the room must also be controlled such that there is no air moisture build up on the skin, perspiration, or vapor levels that can interact with radiant infrared energy. The examining room must have an ambient temperature thermometer to accurately monitor the temperature of the room.

Indications

Gratt and Anbar summarized the following clinical applications for thermography in dentistry:

1. Evaluation of atypical odontalgia
2. Diagnosis of chronic orofacial pain
3. Assessment of temporomandibular disorders (internal derangement of TMJ)
4. Assessment of inferior alveolar nerve deficit



Appendices

Section 1—Oral Medicine

TERMINOLOGY USED IN ORAL MEDICINE

Abrasion: Pathologic wearing away of tooth substance due to an abnormal mechanical process, e.g. faulty tooth brushing technique.

Abscess: Localized collection of pus.

Ageusia: A total lack of taste perception.

Atrophy: A decrease in the size of a normally developed organ or tissue.

Attrition: It is the physiological wearing away of tooth substance as a result of tooth to tooth contact, e.g. age related wearing away of the occlusal/incisal surfaces, bruxism.

Blanching: This is a term of French origin meaning white. It refers to change in colour of a tissue to a paler and lighter shade when pressure is applied.

Bulla: Elevated blister containing clear fluid and greater than 5 mm in diameter, e.g. Pemphigus, Pemphigoid, Erythema Multiforme.

Cachexia: Is a state of decreased tissue or organ mass resulting from a state of malnutrition or underlying severe debilitating disease.

Case history: It is a planned, professional conversation between the patient and the clinician in which the patient reveals his/her symptoms, fears, or feelings to the clinician so that the nature of the real or suspected illness and mental attitude to it may be determined.

Cyst: It is a pathologic cavity filled with a fluid, semi fluid or gaseous material but not by pus, which may frequently but not always lined by epithelium.

Dental caries: It is a microbial infection affecting the calcified tissues of teeth, characterized by the demineralization of the inorganic portion and destruction of the organic portion.

Differential diagnosis: Is the process of identifying a condition by differentiating it from all pathological processes that may produce similar lesions.

Disorder, congenital: It is the disorder which occurs during the development process (intrauterine life). The manifestation of which is seen either at birth or later in life.

Disorder, developmental: It is the abnormality that occurs during the formative stage of an organ or tissue.

Disorder, genetic: It is a disorder caused by abnormality in the gene or an abnormality in mutation.

Disorder, inherited: It is the disorder, which is transmitted through genes to the off spring of the next generation or to subsequent generations.

Dysgeusia: An altered taste sensation.

Erosion (wasting disease): is the loss of tooth substance by a chemical process that does not involve known bacteria, e.g. Excessive consumption of citrus fruits.

Erosion: Is a shallow defect in the oral mucosa representing a loss of covering epithelium down to, but not involving the stratum germinatum. e.g. Erosive Lichen Planus.

Fascial spaces: These are potential tissue spaces through which infection spreads easily (examples: submandibular space, buccal space, pterygomandibular space).

Final diagnosis: Is the diagnosis arrived at after all the data has been collected, analyzed and subjected to logical thought.

Fistula: It is an abnormal communicating tract between two epithelial surfaces or organs. A fistulous tract is generally lined with granulation tissue but over a period of time may become epithelialized.

Glossodynia: It refers to pain in the tongue.

Glossopyrosis: Burning sensation in the tongue.

Hamartoma: It is an abnormal proliferation of tissues of structures native to the part.

Haematoma: It is a tumor like mass produced by coagulation of extravasated blood in to tissues from ruptured blood vessels.

History of presenting illness: It is a chronological account of the chief complaint and associated symptoms from the time of onset to the time the history is taken.

Hypertrophy: Increase in the size or volume of a tissue or organ as a result of enlargement of the cell.

Lesion: Is a morphological alteration of the tissue with objective signs of disease.

Leukoplakia: It is a non-scrapable whitish patch or plaque that cannot be characterized clinically or pathologically as any other disease, and is not associated with any physical or chemical causative agent except the use of tobacco.

Macule: Is a circumscribed non-raised area of altered coloration varying in size from a pinhead to several centimeters in diameter, e.g. petechiae; melanin pigmentation in Addison's disease.

Necrosis: Death of a cell as a result of disease or injury.

Neoplasm: Is an abnormal mass of tissue, the growth of which exceeds and is uncoordinated with that of the normal tissues and persists in the same excessive manner after cessation of the stimuli which evoked the change.

Neuralgia: It is the pain that is experienced in the tissues along the distribution of the nerve.

Nevus: Is a small flat elevated pigmented or nonpigmented lesion of congenital origin involving the skin or mucous membrane.

Nodule: Is a solid, elevated lesion varying in size from 5 mm to 2 cm. Eg: Fibroma.

Oral diagnosis: It is the art of using scientific knowledge to identify oral disease process and to distinguish one disease process from the other.

Oral medicine: Oral medicine is the specialty of dentistry that is concerned with the oral health care of medically compromised patients and with the diagnosis and non-surgical management of medically related disorders or conditions affecting the oral and maxillofacial region. Oral medicine specialists are concerned with the non-surgical medical aspects of dentistry. These specialists are involved in the primary diagnosis and treatment of oral diseases that do not respond to conventional dental or maxillofacial surgical procedures. The practice of oral medicine will provide optimal health to all people through the diagnosis and management of oral diseases.

OSMF: It is a chronic insidious disease affecting any part of the oral cavity and sometimes the pharynx. Occasionally preceded by and /or associated with vesicle formation, it is always associated with a juxta-epithelial inflammatory reaction followed by a fibroelastic change of

lamina propria, with epithelial atrophy leading to stiffness of the oral mucosa and causing trismus and inability to eat.

Pain: It is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.

Papule: Small circumscribed solid elevated lesion varying in size from a pinhead to 5 mm, e.g. Fordyce's Granules.

Paraesthesia: It is an altered sensation or abnormal sensation (tingling sensation).

Plaque: Is a circumscribed solid elevated lesion greater than 5 mm in diameter, e.g. Leukoplakia.

Precancerous condition: Is a generalized state associated with a significantly increased risk of cancer, e.g: Plummer Vinson syndrome, Oral submucous Fibrosis.

Precancerous lesion: Is a morphologically altered tissue in which cancer is more likely to occur than its normal counterpart, e.g; Erythroplakia, Leukoplakia.

Prognosis: Is the prediction of the course, duration and termination of a disease and the likelihood of its response to treatment.

Purpura: Reddish to purple flat lesions caused by blood leaking into the subcutaneous tissue. They do not blanch on pressure. Depending on their size they are termed as.

Petechiae: Pinpoint purpuric spots, 1-2 mm in diameter.

Ecchymosis: Larger purpuric lesions.

Pustule: Is a vesicular type of lesion containing pus, Eg: Pyostomatitis.

Red lesion: Is a nonspecific term used to describe any area on the oral mucosa that on clinical examination appears more red than the surrounding tissues and is usually velvety or granular or smooth in texture.

Sarcoma: It is a malignant tumor arising from connective tissue.

Sign: Is any change in the body or its function, which is perceptible to a trained observer and may indicate a disease.

Sinus: It is a blind tract that connects a cavity lined by granulation tissue to the epithelial surface. The granulation tissue lining the cavity may subsequently become epithelialised.

Swelling: It is a non-specific term used to describe any enlargement or protuberance in the body.

Symptom: Is any change in the body or its function, which is perceptible to the patient and may indicate a disease.

Tumor: The term is used to describe any enlargement, especially one due to a pathologic overgrowth of tissue.

Ulcer: Breach in the continuity of the surface epithelium of the skin or mucous membrane to involve the underlying connective tissue as a result of micromolecular cell death of the surface epithelium or its traumatic removal.

White lesion: Is a nonspecific term used to describe any area of the oral mucosa that on clinical examination appears whiter than the surrounding tissues and is usually raised, roughened or otherwise of a different texture than the adjacent normal tissue.

Vesicle: Elevated blisters containing clear fluid and less than 5 mm in diameter, e.g: Herpes simplex infection, Herpangina, Herpes Zoster.

SYNDROMES OF THE HEAD AND NECK

The word 'syndrome' was used by Hippocrates to a group of regularly concurrent signs and symptoms that could result from a similar cause. The term 'syndrome' has been used in English language since 1541.

A syndrome is defined as the aggregate of signs and symptoms associated with any morbid process that together constitute the feature of the disease. Clinically the term implies that several outwardly diverse clinical features are actually manifestations of a common cause.

CLINICAL SYNDROME

The presence of multiple manifestations implies the possibility that the abnormalities may be related by a common metabolic or a developmental condition. If that is the case then the condition represents a clinical syndrome.

Factors that Complicate the Identification and Evaluation of a Syndrome.

1. A disease that produces multiple lesions of similar character should be categorized by the primary manifestation as *multifocal* rather than as *multiple abnormalities* of a clinical syndrome.
2. Multiple manifestations of one underlying process can be difficult to distinguish at times from the primary manifestations of several different conditions that affect the patient by coincidence.
3. Many patients especially of advancing age may exhibit abnormalities caused by dozens of different diseases that are totally unrelated except they all affect the same patient.
4. Finally the rare occurrence and large number of different syndromes that can affect the oral and perioral structures challenge the clinician.

The only way, often, to identify the syndrome is to recognize the combination of clinical features that characterize the syndrome. The important diagnostic issue to appreciate is that the possibility of the clinical syndrome must be considered when a patient exhibits several apparently dissimilar abnormalities.

CLASSIFICATION / NOMENCLATURE OF SYNDROMES

At present there is no complete agreement concerning what constitutes

a syndrome. However, there have been various attempts to classify syndromes, a few of them are given below.

1. According to EPONYM (Albright's syndrome)
2. According to AETIOLOGY (Crush syndrome)
3. According to PATHOGENESIS (Dumping syndrome)
4. According to ANATOMIC LOCATION (Oculodento digital dysplasia)
5. According to MAIN SYMPTOM (Progressive hemi facial atrophy)

Syndromes of interests to the dentist can be categorized by the stage of development in which they become clinically identifiable either soon after the birth or later in life.

Soon After Birth

Syndromes that are identifiable soon after the birth result from genetic defects (Adverse influences during gestation).

They can be further classified by clinically obvious feature within one of the following groups:

- Deficient mandibular development
- Deficient maxillary development
- Generalized connective tissue deficiency
- Defective skin formation or discoloration of skin

Syndromes Apparent Later in Life

Syndromes that are seen in later part of the life can be:

- Genetically determined
- Acquired by various pathologic mechanisms like
 1. Autoimmune conditions
 2. Degenerative disease
 3. Infections

Developmental syndromes with oral features present a diagnostic challenge because most examples occur relatively rarely, which limits the clinicians opportunity to gain direct contact or familiarity with many examples.

SYNDROMES ASSOCIATED WITH INTRAORAL MANIFESTATIONS

Apert Syndrome (Acrocephalo syndactyly)

Intraoral Features

- High arched palate

- Cleft palate (30% of cases)
- V-shaped maxillary teeth
- Bulging of alveolar ridge
- Class-III malocclusion
- Hypoplastic maxilla.

Associated Abnormalities

- High steep forehead
- Hypertelorism
- Proptosis
- Exophthalmos with divergent strabismus
- Syndactyly of hands and feet
- Short upper extremities
- Mild mental retardation
- Acne vulgaris on the fore arms

Chondro-Ectodermal Dysplasia (Ellis-van Creveld Syndrome)

Intraoral Features

- Absent mucobuccal/mucolateral fold (usually seen in infancy)
- Hypoplasia of the middle portion of the upper lip
- Natal teeth
- Oligodontia
- Tooth eruption is often delayed
- Enamel hypoplasia, peg shaped teeth
- Supernumerary teeth.

Associated Abnormalities

- Short stature
- Chondrodysplasia of long bones
- Congenital heart disease
- Hypoplastic nails
- Dysplastic pelvis.

Cranio Carpo Tarsal Dysplasia (Whistling face syndrome)

Intraoral Features

- Microdontia
- Decrease in intercommissural distance
- Small tongue and mandible.

Associated Abnormalities

- Mask like face
- Hypertelorism
- Delayed growth
- Nostrils colobomas
- Ulnar deviation of hands
- Epicanthic folds

Cranio-Facial Dysostosis (Crouzon syndrome)*Intraoral Features*

- Crowding of maxillary anteriors
- V-shaped dental arch
- Oligodontia
- Macrodonia
- Peg shaped teeth with spacing

Associated Abnormalities

- Mid facial hypoplasia
- Mandibular prognathism
- Nose is described as resembling 'parrot's beak'
- Shallow orbits

Cryptophthalmos Syndrome*Intraoral Features*

- Cleft lip
- Cleft palate
- Ankyloglossia

Associated Abnormalities

- Asymmetry of face
- Partial or complete missing of eyebrows
- Unilateral orbital cryptophthalmos
- Hypoplasia of external genitalia

EEC Syndrome (Ectrodactyly ectodermal syndrome)*Intraoral Features*

- Bilateral cleft lip and palate

- Absence of incisors
- Anodontia, oligodontia
- Xerostomia
- Enamel hypoplasia
- Furrowed tongue

Associated Features

- Ectrodactyly congenital assence of all or part of one or more fingers or toes
- Ectodermal dysplasia

Robinow Syndrome (Fetal face syndrome)

Intraoral Features

- Crowded teeth
- Cleft lip
- Cleft palate
- Clefting of lower lip and tongue
- Gingival enlargement
- Macroglossia

Associated Abnormalities

- Fetal face
- Large neuro cranium
- Bulging forehead
- Ocular hypertelorism
- Curving of the little finger (5th finger) towards ring finger clinodactyly of fifth digits
- Hypoplastic genitalia

Goltz-Gorlin Syndrome (Focal dermal hypoplasia)

Intraoral Features

- Papillomas of oral cavity (lips, buccal mucosa or gingiva)
- Hypodontia
- Oligodontia
- Enamel fragility
- Bilateral cleft lip and palate
- Skin atrophy
- Streaky pigmentation

- Telangiectasia
- Multiple papillomas
- Syndactyly
- Polydactyly
- Adactyly
- Asymmetrical face with pointed chin
- Asymmetrical ears
- Sparse eyebrows and hair
- Eye anomalies/strabismus

Median Cleft Palate Syndrome

Intraoral Features

- Cleft lip
- Cleft palate

Associated Abnormalities

- Ocular hypertelorism
- Broad nasal root
- Lack of foramen of the nasal tip
- Median clefting of the nose

Block-Slitz Berger's Syndrome (Incontinentia pigmenti)

Intraoral Features

- Delayed tooth eruption
- Pegged or conical crowned teeth
- Malformed teeth

Associated Abnormalities

- Skin: linear or grouped vesicles at few days of age
- Eyes: Strabismus. Cataracts, retinal detachments
- CNS: mental retardation, microcephaly, hydrocephalus, paresis/paralysis and convulsions

Caffey Silver Syndrome

Intraoral Features

- Swelling of the jaws with new periosteal bone formation followed by resolution
- Symmetrical swelling of body and ramus of the mandible

Associated Abnormalities

- Fever of mild degree and irritability
- Soft tissue swelling of face and thorax
- Less commonly involved are bones of clavicles, tibia and ribs

Popliteal Pterygium Syndrome*Intraoral Features*

- Cleft lip
- Cleft palate
- Pits or fistulas on the lower lip
- Syngnathia

Associated Abnormalities

- Popliteal pterygia (web/wing like triangular membrane) of the neck and axilla
- Hypoplasia of external genitalia

**Occulodento-Digital Syndrome
(Occulo-dento-osseous dysplasia)***Intraoral Features*

- Enamel hypoplasia resembling amelogenesis imperfecta

Associated Abnormalities

- Narrow nose with hypoplastic alae and thin nostrils
- Microcornea
- Iris abnormalities
- Syndactyly
- Camptodactyly (flexion deformity) of the fourth and fifth digits

Orofacial Digital Syndrome (OFD-I)*Intraoral Features*

- Cleft tongue
- Abnormal frenula
- Median pseudocleft of upper lip
- Haematoma of tongue between lobes

Associated Abnormalities

- Hypoplasia of nasal alar cartilage
- Various malformations of digits
- Mental retardation
- Milia of (tiny, benign, keratin filled cysts) pinna

Mohr Syndrome (OFD –II)*Intraoral Features*

- Midline cleft of upper lip
- Lobed tongue

Associated Abnormalities

- Polydactyly
- Conductive deafness
- Bilateral polysyndactyly of first toes

Hutchinson Gilford Syndrome*Intraoral Features*

- Mandibular hypoplasia
- Crowding of teeth
- Retained deciduous dentition
- Yellow brown discoloration of teeth

Associated Abnormalities

- Dwarfism
- Senility
- Frontal and parietal bossing
- Small face
- Prominent scalp veins
- Small and beaked nose
- Dry, brittle and hypoplastic nails
- Alopecia

Rieger Syndrome*Intraoral Syndrome*

- Oligodontia
- Conical crown formation of teeth

Associated Abnormalities

- Broad and flat roof of nose
- Hypoplasia of iris
- Slit like pupils
- Abnormalities of cornea

Saethre Chotzen Syndrome*Intraoral Features*

- Peg shaped or missing lateral incisors
- Cleft palate
- Enamel hypoplasia
- Class-III malocclusion

Associated Abnormalities

- Craniosynostosis
- Low frontal hair line
- Ptosis (Drooping eyelids)
- Stenosis of tear ducts
- Normal intelligence
- Brachydactyly

William's Syndrome (Idiopathic hypercalcemia and supraaortic stenosis)*Intraoral Features*

- Hypodontia
- Microdontia
- Hypoplastic bud shaped teeth
- Absent lower second molars
- Folding and thickening of the buccal mucous membranes

Associated Abnormalities

- Elfin facies (broad forehead, full cheeks, hypertelorism, depressed nasal bridge, lowest and posteriorly rotated ears)
- Growth deficiency
- Mental retardation
- Supra valvular aortic stenosis
- Hypercalcemia (usually disappears during second year of life)

Tuberous Sclerosis

Intraoral Features

- Fibrous growth of the oral mucosa ranging from pin point to pea size
- Enamel defects

Associated Abnormalities

- Cutaneous angiofibromas (nose, cheeks, chin)
- Unilateral or bilateral retinal tumors
- Intracranial calcification and seizures

Ascher's Syndrome

Intraoral Features

- Acquired double lips

Associated Abnormalities

- Blepharochalasis (drooping of tissue between eyebrows and edge of upper eyelid)
- Non toxic thyroid enlargement

Baby Bottle Syndrome (Nursing bottle caries)

- Wide spread carious destruction of deciduous dentition, most commonly the four maxillary incisors, followed by the first molars and then the cuspids
- Absence of caries in the mandibular anteriors
- Caries may be so severe that only root stumps may remain

Jaw Cyst-Basal Cell Nevus-Bifid Syndrome (Gorlin and Goltz syndrome, basal cell nevus syndrome)

- Cutaneous anomalies
 - a. Basal cell carcinoma
 - b. Benign dermal cysts and tumors
 - c. Palmar pitting, palmar and plantar keratosis
 - d. Dermal calcinosis

- Dental and osseous anomalies:
 - a. Odontogenic keratocysts (multiple)
 - b. Mild mandibular prognathism
 - c. Rib anomalies (often bifid)
 - d. Vertebral anomalies
 - e. Brachymetacarpalism
- Ophthalmologic abnormalities
 - a. Hypertelorism with wide nasal bridge
 - b. Dystopia canthorum (lateral displacement of inner canthus of each eye)
 - c. Congenital blindness
 - d. Internal strabismus
- Neurologic abnormalities
 - a. Mental retardation
 - b. Dural calcifications
 - c. Agenesis of corpus callosum
 - d. Congenital hydrocephalus
 - e. Medulloblastomas
- Sexual abnormalities
 - a. Hypogonadism in males
 - b. Ovarian tumors

B-K Mole Syndrome

- Large pigmented nevi and a high risk for the development of malignant melanoma
- Not documented intraorally

Mandibulofacial Dyostosis (Treacher Collins syndrome)

- Antimongoloid palpebral fissures with a coloboma of the outer portion of the lower lids, and deficiency of the eyelashes
- Hypoplasia of the maxilla and mandible
- Malformations of the external ear, and occasionally the middle and the internal ears
- Macrostomia, high palate
- Abnormal position and malocclusion of the teeth
- Blind fistulas between the angles of the ears and the angles of the mouth
- Atypical hair growth in the form of a tongue shaped process of the hair line extending towards the cheeks
- Other facial clefts and skeletal deformities.

Cowden's Syndrome

- Papilloma like or papillomatous lesions of the oral cavity
- Facial trichilemmomas
- Musculoskeletal abnormalities

Down Syndrome

Intraoral Features

- Macroglossia with protrusion of the tongue
- Fissured or pebbly tongue due to enlargement of the papillae
- High arched palate
- Teeth are malformed with hypoplasia and microdontia
- Periodontal destruction
- Dental caries is rarely seen

Associated Abnormalities

- Flat face with a large anterior fontanelle and open sutures
- Small slanting eyes with epicanthal folds
- Open mouth
- Frequent mandibular prognathism
- Sexual underdevelopment
- Cardiac abnormalities
- Hyper mobility of the joints

Gorham Syndrome

Intraoral Features

- Facial asymmetry or pain or both
- Destruction of the mandible or maxilla

Associated Abnormalities

- Massive osteolysis of the bone most commonly involving the clavicle, scapula, humerus, ribs, ilium, ischium, and sacrum
- Pathologic fracture following trauma

Gardner's Syndrome

- Multiple polyposis of the large intestine
- Osteomas of the bones, including long bones, skull, and jaws

- Multiple epidermoid or sebaceous cysts of the skin, particularly on the scalp and back
- Occasional occurrence of dermoid tumors
- Impacted supernumerary and permanent teeth

Sjögren's Syndrome (SICCA Syndrome, Gougerat-Sjögren Syndrome)

- Keratoconjunctivitis sicca
- Xerostomia
- Rheumatoid arthritis

Secondary Sjögren's Syndrome

- Systemic lupus erythematosus
- Polyarteritis nodosa
- Polyarthritis

Grinspan's Syndrome

- Lichen planus
- Diabetes mellitus
- Vascular hypertension

Peutz-Jeghers Syndrome (Hereditary intestinal polyposis syndrome)

Intraoral Features

- Melanin pigmentation of the buccal mucosa, gingiva and hard palate.

Associated Abnormalities

- Melanin pigmentations around the eyes, nostrils, mucosal surface of the lips, particularly the lower lip
- Abdominal pain and signs of minor obstruction
- Intestinal polyposis of entire intestine but clinically manifested in the small intestine

Marfan's Syndrome (Marfan-Achard Syndrome)

Intraoral Features

- High arched palatal vault

- Bifid uvula
- Malocclusion
- Occasionally multiple odontogenic cysts of maxilla and mandible
- Sometimes temporomandibular dysarthrosis

Associated Abnormalities

- Excessive length of the tubular bones resulting in dolichostenomelia (unusually thin and long extremities)
- Disproportionately long thin extremities
- Arachnodactyly or spidery fingers
- Hyperextensibility of the joints with habitual dislocations
- Kyphosis or scoliosis
- Flat foot
- Bilateral ectopia lentis
- Cardiovascular complications include aortic aneurysm, aortic regurgitation, valvular defects and enlargement of heart

Myofascial Pain-Dysfunction Syndrome

Temporomandibular joint examination shows

- Muscle tenderness
- Pain
- Clicking or popping noise in the temporomandibular joint
- Limitation of the jaw motion, unilaterally or bilaterally in approximately an equal ratio, sometimes with deviation on opening
- Patients will also have two typical *NEGATIVE* disease characteristics
- An absence of clinical, roentgenographic or biochemical evidence of organic changes in the joint itself
- Lack of tenderness in the joint when it is palpated through the external auditory meatus.

Median Cleft Face Syndrome (Frontonasal dysplasia/Burian's syndrome)

- Hypertelorism
- Median cleft of the premaxilla and palate
- Cranium bifidum occiput (abnormal gap in the skull covered by skin)

MEN Syndrome (Multiple Endocrine Neoplasia Syndrome)

This syndrome is classified into Type I (MEN-I) Type II (MEN-II) and a Type III (MEN-III)

MEN I consists of

- Tumors or hyperplasias of the pituitary, parathyroids and adrenal cortex
- Pancreatic islets occurring in association with peptic ulcers and gastric hypersecretion

MEN II (Sipple's syndrome)

- Parathyroid hyperplasia or adenoma but not tumors of pancreas
- Pheochromocytomas of the adrenal medulla
- Medullary carcinoma of the thyroid gland
- Peptic ulcer

MEN III

- Mucocutaneous neuromas
- Pheochromocytomas of the adrenal medulla
- Medullary carcinoma of the thyroid gland
- Marfanoid habitus (slender body build, with long, thin extremities, muscular hypotonicity and increased laxity of the joint)
- Thickened eye lids as a result of neuromas

Intraoral Features

- Presence of multiple neuromas of the lips, tongue, buccal mucosa
- Puffy lips
- Neuromas of the tongue are usually found in the anterior third

Miescher's Syndrome (Cheilitis granulomatosa)

- Swelling of the lip (especially lower lip)
- Skin and adjacent mucosa may be normal or erythematous
- Sometimes scaling or fissuring and vesicles and pustules of the vermillion border of the lip are seen.

Papillon-Lefevre Syndrome

Intraoral Features

- Severe destruction of the alveolar bone involving both the deciduous and permanent dentitions
- Premature exfoliation of the teeth
- Inflammatory gingival enlargement
- Gingival ulceration
- Formation of deep periodontal pockets

Associated Abnormalities

- Keratotic lesions of the palmar and plantar surfaces
- Generalized hyperhidrosis
- Very fine body hair
- Dirty colored skin

Parry-Romberg Syndrome (Facial hemiatrophy)*Intraoral Features*

- Hemiatrophy of the lips and the tongue
- Retarded root development
- Reduced growth of the jaws on the affected side
- Eruption of the teeth on the affected side may also be retarded

Associated Abnormalities

- Atrophy of the skin, subcutaneous tissue, muscle and bone resulting in facial deformity
- Hollowing of the cheek and depressed eye in the orbit
- Darkly pigmented skin
- Loss of facial hair
- Sometimes vitiligo may develop

Pierre Robin Syndrome*Intraoral Features*

- Cleft palate
- Micrognathia
- Glossoptosis
- Hypoplasia of the mandible producing characteristic “bird facies”

Associated Abnormalities

- Respiratory difficulty
- Skeletal anomalies
- Ocular lesions
- Mental retardation

Reiter's Syndrome*Intraoral Features*

- Painless, red, slightly elevated areas sometimes granular or vesicular, with a white circinate border on the buccal mucosa, lips and gingiva

- Palatal lesions are small bright red purpuric spots which darken and coalesce.

Associated Abnormalities

- Urethritis (Urethral discharge with an itching and burning sensation)
- Arthritis (Often bilaterally symmetrical and usually polyarticular)
- Conjunctivitis (Usually very mild)
- Mucocutaneous lesions like Keratoderma blennorrhagica (scaly rashes on palms and soles)

Rubinstein -Taybi Syndrome

- Developmental retardation
- Broad thumbs and great toes
- Delayed or incomplete descent of testes in males
- Bone age below the fiftieth percentile
- Sometimes talon cusp

Scheuthauer-Marie-Sainton Syndrome (Cleidocranial dysplasia)

Intraoral Features

- High, narrow, arched palate and cleft palate
- Underdeveloped maxilla/enlarged mandible
- Prolonged retention of the deciduous and subsequent delayed eruption of the permanent teeth.
- Roots may be deformed and appear thinner
- Absence of the cellular cementum in both deciduous and permanent dentition
- Unerupted supernumerary teeth/partial anodontia

Associated Abnormalities

- Skull fontanelles often remain open or exhibit delayed closure
- Frontal, parietal, and occipital bones are prominent
- Paranasal sinuses are underdeveloped and narrow
- Brachycephaly
- Defect in shoulder girdle and in some cases complete absence of the clavicles (10%)
- Underdeveloped lacrimal and zygomatic bones

Senear-Usher Syndrome (Pemphigus erythematosus)

- Fever and malaise
- Occurrence of vesicle and bullae
- Crusted patches resembling seborrheic dermatitis

**Stevens-Johnson Syndrome
(Severe bullous form of erythema multiformae)**

- Oral cavity: mucosal vesicles or bullae which rupture to leave surfaces covered with a thick white or yellow exudate
Lips may show ulceration with bloody crustings
- Eye lesions: Conjunctivitis, corneal ulceration, and panophthalmitis
- Genital lesions: Nonspecific urethritis, balanitis and vaginal ulcers
- Fever, malaise and photophobia

Trotter's Syndrome

- Asymmetry and defective mobility of the soft palate of the affected side
- Trismus of the internal pterygoid muscle
- Nasopharyngeal tumor

Van Buchem Disease or Syndrome

- Face may appear swollen
- Widening of the angles of the mandible
- Widening at the bridge of the nose
- Loss of visual acuity
- Loss of facial sensation and some degree of facial paralysis
- Deafness
- Sometimes overgrowth of the alveolar process

Van Der Woude's Syndrome

- Pits of the lower lips
- Cleft lip and/or cleft palate

**Weber-Cockayne Syndrome
(Localized form of epidermolysis bullosa)**

- Recurrent bullous eruption on the hands and feet
- Related to frictional trauma and exacerbate in hot weather
- No scarring upon healing.

SYNDROMES ASSOCIATED WITH ENDOCRINAL AND METABOLIC DISEASES

Hurler Syndrome

Intraoral Features

- Enlarged tongue
- Short and broadened mandible
- Hyperplastic dental follicles
- Delayed eruption
- Gingival hyperplasia
- Open mouth

Associated Abnormalities

- Prominent forehead
- Broad saddle nose with wide nostrils
- Hypertelorism
- Puffy eye lids
- Coarse bushy eyebrows
- Thick lips
- Claw hand
- Mental retardation

Adrenogenital Syndrome

Intraoral Features

- Premature eruption of teeth

Associated Abnormalities

- Pseudohermaphroditism
- Sexual precocity
- Virilism in women or feminization in men

Cushing's Syndrome

Intraoral Features

- Osteoporosis
- Cessation of epiphyseal growth

Associated Abnormalities

- Acquired adiposity of upper portion of the body
- Mooning of the face and plethoric (red) face
- Round shoulder
- Buffalo hump at the base of the neck
- Dense hair
- Muscular weakness
- Vascular hypertension
- Glycosuria (not controlled by insulin)
- Albuminuria
- Purple striae over abdomen, thigh plethoric faces (red)

Beckwith's Hypoglycemia*Intraoral Features*

- Macroglossia

Associated Abnormalities

- Neonatal hypoglycemia
- Mild microcephaly
- Umbilical hernia
- Postnatal somatic gigantism

**Menkes Syndrome/Steely hair syndrome/
Menkes kinky hair disease**

- Caused as a result of copper deficiency
- It is an x-linked recessive disorder

Associated Features

- Pili torti
- Sparse, eyebrow hair/eyelashes
- Hypopigmented and doughy skin
- Cupid's bow shaped upper lip
- Lethargy, seizures, hypothermia

Albright's Syndrome

- Endocrinal abnormalities
- Severe fibrous dysplasia nearly of all bones in skeleton
- Pigmented lesions of the skin



SYNDROMES ASSOCIATED WITH NERVES

SUPPLYING THE OROFACIAL REGION

Frey's Syndrome (Auriculotemporal syndrome)

- Flushing or sweating of involved side of the face in the temporal area during eating

Raeder's Syndrome

- Severe pain or headache in the area of trigeminal nerve distribution
- Ocular sympathetic paralysis

Horner's Syndrome

- Miosis (contraction of the pupil of the eye due to paresis of dilators of pupil)
- Ptosis (Drooping of eyelid due to the paresis of the smooth muscle elevator of the upper eyelid)
- Typical facial sweating and facial pain
- Sensory loss

Jaw Winking Syndrome (Marcus Gunn phenomenon)

- Congenital unilateral ptosis
- Rapid elevation of the ptotic eyelid occurs on movement of the mandible to the contralateral side)

Marin Amat Syndrome (Inverted Marcus Gunn phenomenon)

- Eye closes automatically when the patient opens his mouth forcefully and fully as in chewing
- Tears may flow

Mobius Syndrome

- Deficient development of cranial muscles
- Facial diplegia
- Bilateral paralysis of ocular muscles
- Failure to close the eyes during sleep
- Paresis of tongue
- Mental defects
- Epilepsy

James Ramsay Hunt Syndrome (Hunt's syndrome)

- Zoster infection of the geniculate ganglion
- Facial paralysis
- Pain of the external auditory meatus and pinna of the ear
- Vesicular eruption of oral cavity and oropharynx
- Hoarseness of voice
- Tinnitus
- Vertigo

Melkersons Rosenthal Syndrome

- Recurrent attacks of facial paralysis
- Nonpitting, noninflammatory painless edema of the face
- Chelitis granulomatosa
- Fissured tongue/lingua plicata

Heerfordt's Syndrome (Uveoparotid fever)

- Commonly associated with seventh nerve paralysis
- Bilateral painless enlargement of the parotid glands
- Inflammation of the uveal tracts of the eye
- Swollen lacrimal glands
- Xerostomia

Eagle's Syndrome

- Elongation of the styloid process
- Dysphagia
- Sore throat
- Otalgia
- Vague facial pain
- Glossodynia

SYNDROMES ASSOCIATED WITH BLOOD FORMING APPARATUS**Aldrich Syndrome***Intraoral Features*

- Spontaneous bleeding from the gingiva
- Palatal petechiae

Associated Abnormalities

- Thrombocytopenic purpura
- Eczema
- Increased susceptibility to infection
- Ecchymosis of the skin
- Decreased serum IgM

Bing Neel Syndrome*Intraoral Features*

- Gingiva hemorrhage
- Bleeding oral ulcers on the tongue, buccal mucosa or gingiva
- Salivary gland involvement with xerostomia

Associated Abnormalities

- Hyperglobulinemia
- Central nervous system involvement

Plummer Vinson Syndrome*Intraoral Features*

- Cracks or fissures at the corner of the mouth
- Painful tongue
- Atrophy of the filiform papillae and later fungiform papillae
- Dysphagia due to esophageal stricture
- Atrophy of the mucous membranes of the oral cavity and esophagus with loss of normal keratinization

Associated Abnormalities

- Lemon tinted pallor of the skin
- Spoon shaped finger nails (Koilonychia)

Lazy Leukocyte Syndrome*Intraoral Features*

- Stomatitis
- Oral ulcerations
- Gingivitis/periodontitis

Associated Abnormalities

- Otitis media
- Bronchitis

Chediak Higashi Syndrome*Intraoral Features*

- Ulcerations of the oral mucosa
- Gingivitis
- Glossitis
- Periodontal disease

Associated Abnormalities

- Oculocutaneous albinism
- Photophobia
- Nystagmus
- Recurrent infections of respiratory tract and skin
- Neurologic problems
- Gastrointestinal disturbances
- Hepatosplenomegaly
- Generalized lymphadenopathy
- Sometimes associated with malignant lymphoma

Fanconi's Syndrome

- Aplastic anemia
- Microcephaly
- Hypogentalism
- Generalized olive-brown pigmentations of the skin

Malabsorption Syndrome*Intraoral Features*

- Glossitis with atrophy of the filiform papillae
- Burning sensation of the tongue and the oral mucosa

Associated Abnormalities

- Intestinal disturbances including diarrhea, constipation and flatulence
- Malaise and generalized weakness

- Irregular brownish pigmentations of the skin (face, neck, arms and legs)
- Drying of the skin with scaly eruptions

SYNDROMES ASSOCIATED WITH SPECIFIC SYSTEM

Skin

CREST Syndrome

- Calcinosis cutis
- Raynaud's phenomenon
- Esophageal stricture
- Sclerodactyly
- Telangiectasia

Ehlers-Danlos Syndrome (Circus rubber man)

- Hyper extensibility of joints
- Fragile oral mucosa which is easily bruised
- Lack of normal scalloping of the dentinoenamel junction
- Formation of irregular dentin
- Passage of many dentinal tubules into enamel
- Hypoplastic enamel (occasionally)
- Extensive periodontal destruction

Associated Abnormalities

- Excessive bruising and defective healing of skin wounds
- Hypertelorism
- Wide nasal bridge and epicanthic folds
- Protruding ears and frontal bossing

Behcet's Syndrome

Intraoral Features

- Recurrent oral ulcerations

Associated Abnormalities

- Photophobia
- Ocular inflammation
- Recurrent genital ulcerations

- Skin lesions
- Ulcerative colitis
- Arthritis

Costen's Syndrome

- Impairment of hearing, either continuous or intermittent
- Stuffy sensation in the ears, especially at mealtime
- Tinnitus, sometimes accompanied by a snapping noise when chewing
- Otalgia
- Dizziness
- Headache about the vertex, occiput and behind the ears, sometimes increasing toward the end of the day
- Burning sensation in the throat, tongue and side of the nose.



MEDICAL MANAGEMENT OF COMMON OROFACIAL DISEASES

DENTINAL HYPERSENSITIVITY

The management of dentinal hypersensitivity should be targeted at the cause of the hypersensitivity

Dentinal exposure can be caused because a carious lesion, wasting diseases like attrition, abrasion and erosion of the tooth structure, fractured crown with dentine involvement and marginal leakage around restorations

Management

1. Carious lesions, abrasions and erosions should be restored
2. Marginal leakage around restorations can be rectified by redoing the restoration
3. Patient can be prescribed desensitizing tooth pastes

Should be used atleast two times a day. The paste can be brushed gently over teeth and left in place for about 2-3 minutes before rinsing it off. Alternatively desensitizing mouth washes can be used. Chlorhexidine mouth washes used for prolonged periods (about 3-4 weeks) has known to stain teeth

DRY SOCKET

1. The socket should be debrided of unsupported pieces of bone and tissue fragments
2. The socket should be irrigated gently with warm saline
3. The socket should be packed with the dressing (the dressing should be protective, antiseptic, obtundant and non irritant in nature)
4. Zinc oxide eugenol packs can be placed within the socket
5. Analgesics such as Ibuprofen or Paracetamol can be used
6. Antibiotics generally do not have a major role in the management of a dry socket

However topical antibiotics in the form of Metronidazole along with orabase can be used

Systemic antibiotics are indicated only in the presence of cervical lymphadenopathy

Metronidazole is the drug of choice.

Metronidazole 400 mg five times a day is prescribed. However it is contraindicated in alcoholics, pregnant patients and patients on medication with warfarin or phenytoin.

Pulpal Pain

Pulpal pain can be initially managed with non-steroidal anti inflammatory drugs. However the specific management is by endodontic treatment.

ACUTE PERIAPICAL INFECTIONS

Apical Periodontitis

Acute apical periodontitis can be managed with non-steroidal anti-inflammatory drugs followed by endodontic treatment.

Acute Periapical Abscess

Patients should be strictly advised not to use moist heat fomentation (helps in spreading the infection through fascial spaces).

Amoxycillin 500 mg three times a day for 5 days.

Non-steroidal anti-inflammatory agents.

Followed by endodontic treatment or extraction chronic periapical abscess can be managed with endodontic treatment or extraction of the tooth (antibiotics are not required).

Chronic Periapical Abscess

CELLULITIS

Amoxycillin 500 mg three times a day for five days.

Metronidazole 400 mg three times a day for five days.

Non steroidal anti-inflammatory agents.

In severe cases with multiple fascial space involvement parenteral administration of antibiotics is necessary. Surgical intervention in the form of surgical drain and removal of the offending tooth may be indicated.

PERIODONTAL/PERICORONAL ABSCESS

Patient should be instructed to use warm saline rinses at least after every meal.

Amoxycillin 500 mg three times a day for 5 days.

Metronidazole 400 mg three times a day for three to five days.

Non-steroidal anti-inflammatory agents.

Specifically managed by curettage for periodontal abscess and operculectomy or removal of the tooth (if impacted) in a pericoronal abscess.

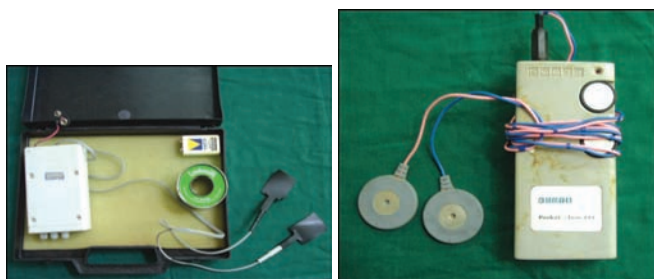
TRAUMATIC ULCERS

1. Eliminate the cause for trauma if still persisting (round off sharp cusps, ectopically placed teeth to be removed, trim over extended dentures, rough edges to be smoothened).
2. If the patient is a denture wearer, advise discontinuation the denture until the time the ulcer heals.
3. Topical application of Lignocaine/Benzocaine over the ulcer 5 minutes before consumption of meals three to four times per day.
4. Chlorhexidine mouth rinses three to four times a day after meals.
5. Review the patient after 3 weeks. If the ulcer does not show signs of healing, an excisional or incisional biopsy as per the indication is advised to evaluate for malignant changes.

TRIGEMINAL NEURALGIA

The rationale behind using a medical line of treatment for trigeminal neuralgia is to minimize the painful attacks. Anticonvulsants are the drugs of choice. Carbamazepine is commonly used and has an efficacy of 85%. In cases where the patient does not respond to increased doses of carbamazepine it can be combined with Baclofen. Another newer anticonvulsant that has been tried is Gabapentin, though it does not seem as effective as carbamazepine.

1. *Carbamazepine*: 100 to 200 mg per day; once or twice per day. Subsequently increased to 800 to 1200 mg per day as per the requirement. Up to a maximum of 1600 mg per day.
Note: Patients on long-term carbamazepine should have regular hematological investigations done in order to evaluate for blood dyscrasias. Hepatic and renal functions also need to be evaluated.
2. Baclofen: 30 to 75 mg of Baclofen per day in divided doses can be given along with Carbamazepine.
3. Gabapentin (not as effective of Carbamazepine).
Initially 300 mg once a day followed by 300-600 mg thrice a day as per requirement.
Up to a maximum of 2.4 gm per day in three divided doses.



Figs AP-1A and B: Showing TENS equipment

GLOSSOPHARYNGEAL NEURALGIA

1. Topical application of local anesthetic agent (lignocaine, benzocaine) to the pharyngeal mucosa to minimise the pain.
2. Carbamazepine: 100 to 200 mg per day; once or twice per day. Subsequently increased to 800 to 1200 mg per day as per the requirement. Up to a maximum of 1600 mg per day.

POSTHERPETIC NEURALGIA

Conventional analgesics are of little value in managing post herpetic neuralgia.

Tricyclic antidepressants are effective.

For patients older than 60 years of age: Amitriptyline 10-70 mg per day.

For individuals less than 60 years of age: Amitriptyline 25-75 per day.

Topical capsaicin (0.025%) helps in relieving the pain caused by postherpetic neuralgia.

MYOFASCIAL PAIN DYSFUNCTION SYNDROME (MPDS).

MPDS has a physical and psychological component.

1. Improve the patient physician relationship by showing concern during the initial diagnostic interview.
2. Reassure the patient. Patient should be told that MPDS is not a life threatening condition.
3. Detrimental habits such as bruxism and clenching of teeth should be avoided.

4. Patient should be instructed to consume soft diet.
5. Excessive mouth opening should be avoided.
6. Moist heat fomentation over the affected region 3-4 times a day .
7. Non steroidal anti-inflammatory drugs can be prescribed for about 1 week.
8. Non adrenaline containing local anesthetic agents can be injected into the spastic muscles.
9. Muscle spasm can also be relieved by spraying ethyl chloride over the affected region.
10. Anxiety can be managed with 2 mg Diazepam three times a day or a bed time dose of 5 mg.
11. Patient should be encouraged to exercise his/her jaw muscles. The patient should be told to place the tip of the tongue to the most posterior part of the palate as possible and then open and close the mouth gently. These jaw exercises have known to help in relaxing the spastic muscles.

Other Treatment Modalities

MPDS has also been treated using occlusal splints, TENS (Transcutaneous Electrical Nerve Stimulation), biofeedback, acupuncture and hypnosis.

TENS (Transcutaneous Electrical Nerve Stimulation)

TENS is useful in relieving chronic pain. A battery operated device is used to generate electrical impulses. These electrical impulses are transmitted through the electrodes placed on the skin of the patient at the desired location (Figure 15.1 A and B).

Mecahnism of Action

The exact mechanism of action is not known, however various theories have been propounded.

1. Neurological action: TENS may block pain signals carried by the small unmyelinated "C fibres" by forcing large myelinated "A fibres" to carry sensation of light touch.
2. Pharmacological action: TENS may help in the release of endorphins which are endogenous morphine like substances. These endorphins may contribute to the reduction of pain.
3. Physiological action: The electrical impulses produced by TENS may produce a rhythmic muscular movement which in turn helps in increasing the local perfusion and minimizing edema.

4. Psychological action: Many authors believe that TENS has a placebo effect.

ACUTE NECROTISING ULCERATIVE GINGIVITIS (ANUG)

1st Visit

Patient is instructed to avoid tobacco and alcohol.

Rinse mouth with a glassful of warm water + 3% hydrogen peroxide every 2 hours.

Or

Rinse with 0.12% Chlorhexidine gluconate solution.

Avoid prolonged exposure to sun/physical exertion.

Use tooth brush only for removing surface debris using a bland tooth paste.

2nd Visit

Superficial scaling

Patient is advised to follow the same instructions as above.

3rd Visit

Scaling and root planing

Hydrogen peroxide oral rinse can be discontinued.

Chlorhexidine 0.12% is continued for 2-3 weeks.

For symptomatic or severe cases (associated with lymphadenopathy).

Penicillin antibiotic regime is used.

250 to 500 mg given orally every 6 hours.

Metronidazole 400 mg three times a day for 7 days.

If the patient is allergic to penicillin.

Erythromycin 250 mg to 500 mg can be given orally every 6 hours.

PEMPHIGUS VULGARIS

General Measures

- i. The patient should be treated as an "in-patient" in a hospital.
- ii. Intra venous infusion of fluids, as the patient is dehydrated since there is severe loss of fluids via rupture of bullae.

Specific Management

Initial Therapy

- a. *Oral prednisone*: 150 mg/day. In severe cases 360 mg/day. Generally the lesion clears up in 48 hours, if there is no improvement by the end of 5 days, the dose of prednisone is increased. Some authors believe that high prednisone therapy should be continued for 6 to 10 weeks to decrease the likelihood of relapse. To prevent undesirable side effects, prednisone can be combined with methotrexate, cyclophosphamide and azathioprin.

After Disease Remission

The dosage of prednisone is gradually reduced.

40 mg per day for 1 week.

30 mg per day in the second week.

25 mg per day in the 3rd week.

Finally 40 mg on alternate days. In due course the active treatment should be withdrawn.

Oral prophylaxis is advised. Patient should be instructed to use chlorhexidine mouth rinses to prevent candidal super infection.

MUCOUS MEMBRANE PEMPHIGOID (CICATRICAL PEMPHIGOID)

Eliminate sources of tissue trauma. (Eliminate sharp tooth edges, relined dentures, fabricate new dentures).

Gingival inflammation should be controlled by scaling and root planing.

A non/low alcohol containing 0.12% chlorhexidine gluconate mouth rinse which does not cause mucosal drying is advocated.

For patients who complain of mucosal pain, topical analgesic/anesthetic such as xylocaine 0.2% viscous solution can be recommended.

Systemic steroids are prescribed. Topical steroids combined with orabase, Lidex ointment 0.05% (Flucocinide) and betamethasone valerate can also be used.

APHTHOUS ULCERS

Take into consideration underlying systemic conditions or local factors that might have contributed to the ulcer formation such as oral trauma, dietary factors, haematinic deficiencies, gastrointestinal diseases, cyclic neutropenia and Behcet's syndrome.

Topical Therapy

1. Antiseptics -0.2 % Chlorhexidine mouth rinse.
Chlorhexidine is said to accelerate the healing process by preventing super infection of the aphthous ulcerations.
10 ml of the mouth rinse is used to rinse the oral cavity for 2-3 minutes three times daily after meals.
2. Antibiotics- Topical Tetracycline.
The contents of a 250 mg capsule of tetracycline are dissolved in 10 ml of water. The prepared solution is retained in the mouth and swished around in the mouth for 2-3 minutes and then subsequently swallowed. This is done 3-4 times daily.
The tetracycline mouth rinse is particularly useful for treating Herpetiform recurrent aphthous stomatitis.
3. Topical Steroids.
Triamcinolone (0.05-0.1%) and Flucinolone (0.05-0.1%) cream is applied 3 to 5 times daily. Perilesional infiltrations can be employed for larger lesions. Triamcinolone (5 mg/ml) or Hydrocortisone (25 mg/ ml). Injections are given once in 10-15 days.
4. Topical anesthetic agents.
Benzocaine 20%w/w can be applied topically 5 minutes before meals to minimize pain caused by the irritation of the ulcers with the intake of food.

Systemic Therapy

Systemic therapy is generally not advocated to manage recurrent aphthous stomatitis. However when the local therapy fails systemic treatment can be attempted.

1. Corticosteroids: Prednisone 20 mg two times a day for 5 days, and followed by once a day for one week.
2. Levamisole: 150 mg per day for 3 consecutive days followed by gap of 2 weeks. Then repeat for 3 days. This is done for six time. of Levamisole three times per day.
3. Zinc Sulphate: Patients with zinc levels below 110 micrograms/dl showed a marked reduction in the recurrence of the ulcers when treated with zinc sulphate. 660 mg per day of Zinc sulphate for 3 weeks.

ORAL LICHEN PLANUS

Medical management is indicated only for symptomatic ulcerative and erosive lichen planus.

Essentially three groups of drugs namely, retinoids, corticosteroids and immunosuppressive agents are used in the management of oral lesions of lichen planus.

Retinoids

1. Vitamin A 50000 IU along with Vitamin B complex for 5 weeks.
2. Topical isotretinoin improves the lesion significantly. However, it may produce a transient burning sensation on application.

Corticosteroids

Topical Steroids

1. Topical triamcinolone acetonide applied over the lesion for 3 weeks, 3-4 times a day after meals.
2. Intra lesional triamcinolone acetonide (10-20 mg/ ml) in long standing erosive lesions.

Systemic Steroids

Systemic steroids are generally reserved for severe erosive lesions.

Systemic prednisone.

60-80 mg/day for 2 weeks followed by.

30 to 50 mg /day.

An Alternative Regimen

40 mg daily for 5 days followed by 10-20 mg daily for 2 weeks followed by topical corticosteroid therapy.

Immunosuppressive Agents

Azothioprine – 25-50 mg three times per day.

Azothioprine may be a successful steroid sparing adjunct to systemic prednisolone therapy.

Miscellaneous Agents

Dapsone has been tried with some success in treating resistant cases, bullous and severely eroded lichen planus lesions.

LEUKOPLAKIA

Small white lesions-can be managed medically or excision biopsy can be undertaken.

White lesions with a red component-biopsy is indicated.

1. Advise the patient to discontinue the use of tobacco.
2. Some authors recommend the use of antifungal agents (Topical Clotrimazole for 2 weeks, in order to treat chronic hyperplastic candidiasis which resembles homogenous leukoplakic lesion).
3. Topical vitamin A.
4. Antioxidants (containing alpha lipoic acid, selenium) once daily for 30 days.

ORAL SUBMUCOUS FIBROSIS

1. Patient should be instructed to discontinue the habit of areca nut/ tobacco chewing habit.
2. It is advisable to counsel the patient regarding the irreversible nature of the disease.
3. Patient should be instructed to consume supplementary nutritional diet rich in proteins, calcium and Iron.
4. Burning sensation of the oral mucosa can be managed using topical benzocaine and Benzylamine hydrochloride.
5. Intralesional injections of corticosteroids, fibrinolytic agents and placental extracts.

Corticosteroids has an anti-inflammatory action. Betamethasone 4 mg/ml 1 vial. 1-2 drops of the agent injected along the fibrous bands once a week for about 6 weeks.

Fibrinolytic agents- Hyaluronidase 1500 IU 1 vial mixed with 1 ml of distilled water and 1 ml of lignocaine. 1-2 drops injected along the fibrous bands once a week for 6 weeks.

ORAL CANDIDIASIS

Topical anticandidal agent.

Clotrimazole 0.1% to be applied topically over the lesion 3-4 times a day for 2 weeks.

Systemic anticandidal agents- Generally not used for managing oral candidiasis.

Amphotericin-B 50-100 mg 4 times a day .

Ketaconazole 200 mg once daily.

Fluconazole.

On the first day 200 mg one tablet.

Followed by 100 mg once a day.

XEROSTOMIA

Investigate the underlying cause for xerostomia and rectify the same.

Symptomatic Management

1. Patient is instructed not to consume alcohol, foods containing strong flavors and sugar containing food.
2. Frequent sipping of water.
3. Artificial salivary substitutes (methyl cellulose).
4. Stimulate salivary secretion.

Local agents- chew sour tasting gums, mints, candy and sucking on lemon.

Systemic agents (mucolytic agents) Pilocarpine, Bromhexine, Cevimeline hydrochloride.

Dosage: 5 mg TID orally (pilocarpine)

MANAGEMENT OF MEDICAL EMERGENCIES

Condition	Symptoms/Signs	Management
Syncope Common faint, also called vasodepressor syncope is the most common in a dental setup Severe anxiety is the commonest cause	Symptoms: Nausea, feeling warm, dizziness, headache, confusion Signs: Pallor, tachycardia (early stages), increased respiratory depth, convulsive movements, unconsciousness	• Terminate the dental treatment • Remove all objects from the • Mouth like gauze, cotton rolls • Place patient in a supine position with the lower extremities raised over the level of the head • In pregnant patients in the 3rd trimester place rolled sheets under the right thorax and abdomen. Tilt the patient laterally to the left. (to avoid uterine pressure on major vessels)

Contd...

Contd...

Hyperventilation

Commonly seen in anxious patients who however portray an extremely clam exterior

Palpitations, shortness of breath, peripheral paraesthesia, muscle cramps, tremors, tetany and sweating

Allergy related emergencies

(Anaphylactic shock)

Angioedema, Urticaria, generalized itching of sudden onset, dyspnoea and sudden loss of consciousness

- Remove restrictive clothing around the neck to avoid restriction of cerebral blood flow
- Aromatic ammonia ampoules to be held near the patient's nose
- Assess vital signs periodically
- 100% oxygen administered by nasal cannula
- If bradycardia and hypotension persist IV isotonic crystalloid solution is administered (normal saline or Ringer's lactate)
- Anticholinergic agents 0.4 mg atropine sulfate is administered

- Terminate the dental treatment
- Remove all objects from the mouth like gauze, cotton rolls

- Position the patient upright or in a position comfortable to the patient (supine position will aggravate the dyspneic condition)

- Remove restrictive clothing around the neck
- Patient should be calmly alerted about his rapid breathing. Patient may be guided to briefly hold breath after each exhalation, thus slowing down the rate of respiration
- Rebreathing exhaled air helps in hyperventilation.

Rebreathing can be initiated using a paper bag, or cupping one's own hands around the nose and mouth
Normally resolution of symptoms take 1-4 minutes, however prolonged hyperventilation leads to a syncopal attack

Inj. Adrenaline (1:1000) 0.5 cc subcutaneous or Intramuscular (IM at the rate of 1 ml/minute)

Contd...

Contd...

Lignocaine toxicity	Restlessness, transient period of anxiety, increased pulse rate, tremors, drowsiness, slurred speech, convulsions and lastly loss of consciousness	Aimed at counteracting anxiety convulsions Inj. Diazepam- 10 mg IM or Inj. Gardinal 100 mg IM Inj. Mephentine 10-30 mg IM
Angina	Crushing pain in the chest, substernal region or the pre-cordial region with radiation of pain to the left shoulder and jaw	Tab. Nitroglycerine 0.5 mg sublingual Tab. Sorbitrate 20 mg sublingual
Hypertension	Restlessness, Headache, palpitations and increased pulse rate	Tab. Nifedipine 5 mg sublingual Propranolol 40 mg stat
Hypotension	Giddiness, pallor and thready low pulse	Inj. Mephentine 10-30 mg IM Inj. Decadron 8 mg IM or Inj. Effcorin 100 mg IM
Hypoglycemia	Hunger, sweating, palpitations, headache, anxiousness and convulsions	Glucose 25% 10-20 cc IV
Asthma	Shortness of breath, wheezing, difficulty in breathing and restlessness	Salbutamol 100-200 mg inhaler Inj. Deriphyline 2cc IM Inj. Aminophylline 250 mg (Slow IV dilution in 20 cc glucose)
Epileptic Seizures	Tonic and clonic muscle sprains, Frothing of saliva.	Inj. Phenobarbitone 100-250 mg IM Inj. Diazepam 100 mg slow IV/IM

DIAGNOSTIC TESTS AND INVESTIGATIONS

Schirmer's test

Used to assess the lacrimal secretion.

Procedure: A strip of filter paper is placed in the lower conjunctival sac.

In normal individuals 15 mm of filter paper is wetted in 5 minutes.

Patients with deficient lacrimal secretion will wet less than 5 mm of filter paper.

TESTS FOR SALIVARY SECRETION

Measurement of Parotid flow rate

Production of saliva is stimulated by asking the patient to sip on lemon juice every 30 seconds for 10 minutes.

Saliva from the parotid gland can be collected by placing specially fabricated cups called Lashley or Carlson-Crittenden cups over the orifice of the Stenson's duct.

The normal salivary output is about 5 ml per minute. However in salivary gland dysfunction the salivary output is below 0.5 ml per minute.

Patch test

Test used to distinguish allergic conditions from other lesions.

The suspected allergen is taped onto a site with little or no hair on the skin (skin of the upper back).

The suspected allergen is left in contact with the skin for 48 hours. After the patch is removed, the site is examined after 2-4 hours. Presence of erythema confirms the allergic nature of the substance. (allergy to denture material, amalgam, etc.).

Vital staining with Toluidine Blue (Tolonium Chloride)

Tolonium Chloride is a metachromatic dye of the Thiazine group.

It is used as a nuclear stain because it binds with the DNA.

Uses

1. Helps to confirm clinical impressions regarding tissues at risk for malignancy.
2. To choose the best possible site for a biopsy.

Procedure

1. Apply 1% Toluidine Blue on the suspected lesion.
2. Wait for 3 minutes.
3. Rinse with 1% acetic acid.

The sites with premalignant potential will retain the dye.

Detection of Gustatory Sweating

Minor's starch-iodine test is used to detect Frey syndrome.

A 1% iodine solution is painted on the affected area of the skin.

The solution is allowed to dry, and the area is then coated with a layer of starch.

When the patient is given something to eat, the moisture of the sweat that is produced will mix with the iodine on the skin. This allows the iodine to react with starch and produce a blue color. Iodine sublimated paper, which changes color when wet can also be used.

BIOPSY

It is a process of surgically removing tissue from a patient for histopathologic examination.

Indications

1. Oral ulcers that persist for more than 2-3 weeks even after eliminating the suspected cause.
2. Persistent red and white lesions.
3. Suspected neoplasms.
4. Unidentified tissue mass/pathologic mass.

Types of Biopsy

1. Incisional Biopsy.
2. Excisional Biopsy.
3. Fine needle aspiration.

Handling of specimen: The excised specimen should be immediately stored in 5-10% formalin.

Incisional biopsy

Indicated for large lesions.

Multiple samples from different sites on the lesion have to be obtained (SERIAL BIOPSY).

The sample should be taken from the most suspected area.

Should be relatively deep, large and should include junction with normal surrounding tissue.

Excisional biopsy: Used when the lesion is not larger than 1 centimeter in diameter.

Fine needle aspiration biopsy: It is an accepted and accurate technique for differentiating benign from malignant lesions involving lymph nodes (metastatic carcinoma of the lymph nodes, non Hodgkins and Hodgkins lymphoma).

Procedure: 21-23 gauge needle is inserted into the suspected lesion. Minute piece of tissue is sucked into the needle tip. Aspirated tissue is expressed onto a glass slide, dried and rapidly stained, stained smear is examined under the microscope.

ASPIRATION OF SWELLINGS

Aspiration of swellings is a convenient chair side investigation technique to evaluate the fluid nature and contents of soft, cheesy or rubbery masses. The nature of the material within the mass will significantly influence the formulation of appropriate differential diagnosis.

However, some practitioners do not recommend the aspiration until just before a surgery. It is thought that during the process of aspiration there is a possibility of introducing bacteria from the surface of the swelling, thereby secondarily infecting the mass.

Generally a 21 G needle should be adequate. However, while aspirating from a suspected dermoid cyst, which contains keratin, sebum, sweat and exfoliated squamous cells, a thick, bore needle is recommended such as a 15 G needle. When a vascular lesion is suspected a needle of smaller sized bore should be used.

<i>Suspected lesion</i>	<i>Character of the aspirate</i>
Odontogenic and fissural cysts	Straw colored aspirate When the syringe containing the aspirated fluid is transilluminated, shiny particles (cholesterol crystals) are seen. Cholesterol crystals in the walls of Odontogenic and Fissural cysts are shed into the lumen of the cyst
Epidermoid cyst and Keratocyst	Thick, yellowish white granular fluid (the lumen of these cysts is filled with exfoliated keratin)
Sebaceous cyst	Thick, homogenous and yellow to gray colored aspirate (sebum)

Contd...

Contd...

Dermoid cyst	Yellowish cheesy substance. Thick aspirate, difficult to aspirate (the aspirate contains keratin, sebum, sweat and exfoliated squamous cells)
Thyroglossal duct cyst	Dark amber colored fluid
Cystic Hygroma and Lymphangioma	Colorless, (lymph fluid) cloudy and frothy aspirate (high lipid content)
Early Haematomas, Hemangiomas and Varicosities	Bluish colored blood is aspirated
Aneurysm	Bright red colored blood
Mucocoele, Ranula (retention phenomena)	Sticky, viscous clear fluid
Actinomycosis (intermediate stage)	Yellowish white pus with firm yellow granules
Papillary cystic adenoma, Papillary cystadenoma lymphatosum	Thin, straw colored fluid
Infectious conditions (warm, tender, fluctuant swellings)	Yellow/yellowish white fluid (if the abscess is odontogenic in origin)

VITALITY TESTS

The tooth is said to be vital when it is capable of responding to stimuli.

To check the vitality there are 3 basic stimuli in the form of thermal, electrical or mechanical.

Thermal

- Heat/cold application

Electric Pulp Testing

- Direct electric stimulation of sensory nerves in the pulp .

Mechanical Stimulation

- Blowing air onto exposed dentin.
- Test cavity preparation.

Thermal Test

Procedure (See Figure 17.1).

Adjacent or contralateral unaffected teeth should be tested for baseline comparisons because the duration of pain may differ among individuals.

- A cotton applicator tip sprayed with a freezing agent (CO₂, Snow, Ice sticks, Ethylchloride spray) or gutta percha applied directly to the tooth.

The cold applied immediately to the middle one third of the facial surface of the crown of the tooth/exposed metal surface of crowns kept in contact for 5 seconds/until point begins to feel pain.

Heat Test

Procedure

- Isolate the tooth.
- Gutta Percha in 3 inch sticks is warmed over a flame until it becomes soft and just begins to glisten. (Care to be taken that it is not so hot that it slumps and becomes too limp to use).
- Apply to the middle one third of the facial surface of the crown and usually results in response within two seconds.

Interpretation

1. No Response – a non-vital pulp.
False negative response can be encountered under following conditions.
 - Excessive calcification.
 - Immature apex.
 - Recent trauma.
 - Patient premedication.
2. Momentary mild to moderate response ® Normal pulp.
3. Exaggerate response that subsides quickly ® Reversible pulpitis.
4. Painful response that lasts for several minutes after the stimulus is removed ® Irreversible pulpitis.

Electric Pulp Tester

Evaluation of responding nerve endings can be done with an electrical pulp tester.

A small electric current delivered to the tooth causes a tingling sensation is suggestive of vital pulp.

Procedure (Figure 17.2)

The teeth to be tested must be isolated and dried with gauze and the area must be kept dry with a saliva ejector. Patient must be made aware of the procedure. The electrode should be coated with a viscous

conductor. The electrode should then be applied to the dry enamel of the tooth being tested on the middle one third of the facial surface of the crown.

The digital reading that indicates the current flow should always start with zero. The current flow should be increased slowly to allow the patient to respond for tingling sensation. If a positive response is not obtained the electrode should be applied to several different locations on the lingual and facial surfaces of the tooth to ensure that the negative response is not due to the result of improper electrode placement. Each tooth should be tested at least two or three times and an average result should be recorded. Enamel thickness influences the results. Thinner enamel in the anteriors yields faster response than thicker enamel of the posteriors. Electrodes should not be applied on restorations.

False positive response (when a patient reports sensation in a tooth with a necrotic pulp) can be encountered under following conditions.

- Patient anxiety.
- Saliva conducting the stimulus to the gingiva.
- Metallic restoration conducting the stimulus to the adjacent teeth.
- Liquefaction necrosis conducting the stimulus to the attachment apparatus.

False negative response (although the pulp is vital, patient does not indicate that any sensation is felt in the tooth) can be encountered under following conditions.

- Premedication with drugs or alcohol.
- Immature teeth.
- Trauma.
- Poor contact with the tooth.
- Inadequate media.
- Partial necrosis with vital pulp remaining in the apical portion of the tooth.
- Individuals with atrophied pulps or with high pain thresholds.

Limitations

There is no reasonable assurance, however, that these nerves are located in an intact pulp. Necrotic and degenerating pulp tissue often leaves an excellent electrolyte in the pulp space. This electrolyte can easily conduct the electrical current to nerves further down into the pulp space, simulating normal pulp response. It is more complicated in a multirooted tooth, where the status of the pulp varies in each root.

Electrometric pulp tester should not be the primary instrument of choice when assessing pulpal health. A positive cold test provides a more accurate response that is easier to interpret. However, neither of these tests ensures vitality of the pulp if the results are positive.

DRUGS COMMONLY USED IN THE MANAGEMENT OF OROFACIAL DISEASES

This chapter gives list of commonly used drugs in the medical management of orofacial diseases. The drugs that are listed are analgesics, antibiotics, muscle relaxants, antifungal, antiviral, corticosteroids and other miscellaneous drugs that are used in a dental setting.

The available forms and dosage, mode of action, pharmacological uses, contraindications and side effects of the drugs are listed.

ANALGESICS

Name of the Drug: Ibuprofen (*Propionic acid derivative*).

Available forms and Dosage

Oral preparations: Tablets and Suspensions.

200 mg, 300 mg, 400 mg, 600 mg.

Suspension: 100 mg/5 ml.

Adults: 600 mg-1.8g per day in divided doses.

Children: 10–15 mg/kg/dose every 4-6 hours.

Mode of Action

Inhibits cyclo-oxygenase pathway of prostaglandin synthesis.

Uses

Management of mild to moderate pain.

Contraindications

Cannot be used in patients with peptic ulcers and bronchial asthma.

Patients who are allergic to aspirin and other NSAIDs.

Care to be taken in patients with chronic renal dysfunction.

Side Effects

Nausea, vomiting, headache, dizziness, tinnitus, gastric discomfort and precipitate asthma.

Added note

Not safe to use in pregnant women.

Name of the Drug: *Paracetamol (acetaminophen)**Available forms and Dosage*

Oral preparations: Tablets, syrup (60 ml) and pediatric drops (15 ml) and suspension (60 ml).

125 mg kid tablets, 500 mg and 650 mg tablets.

Suspensions: 120 mg/5 ml, 250 mg/5 ml.

Syrup: 125 mg/5 ml.

Drops: 150 mg/ ml.

Parenteral preparations: Intramuscular Injection.

Adults: 500 mg to 1g three times per day, upto maximum of 4 g per day.

15 mg/ ml, 300 mg/2 ml used as per requirement.

Children:

Less than 3 months: 10 mg per kg body weight per dose, given 4-6 hourly.

3 months to 1 year: 60 to 120 mg per dose, given 4-6 hourly.

1-5 years: 120 to 250 mg per dose, given 4-6 hourly.

6 to 12 years: 250 mg to 500 mg per dose, given 4-6 hourly.

Mode of Action

It blocks prostaglandin synthesis by inhibition of cyclo-oxygenase pathway.

Uses

It is one of the drugs of choice for use as an *antipyretic*. It is an easily available "over the counter" *analgesic*. Not an effective anti-inflammatory agent. (Paracetamol cannot inhibit cyclo-oxygenase enzyme in the presence of peroxides that are generated at the sites of inflammation).

Contraindications

Hypersensitivity and Liver failure.

Side Effects

Nausea, vomiting, skin rashes, leukopenia and overdose results in liver damage.

Added note: Alcohol potentiates paracetamol hepatotoxicity.
Should not be used in patients suffering from jaundice.
Safe in pregnancy, nursing mothers, cardiac failure.

Name of the Drug: Diclofenac Sodium

(PHENYL ACETIC ACID DERIVATIVE)

It is an analgesic, antipyretic and anti-inflammatory drug.

Available froms and Dosage

Oral preparations: tablets, also available in dispersible form.

25 mg, 50 mg, 75 mg, and 100 mg.

Parenteral preparations: 25 mg/ ml (3 ml ampoule) for intramuscular injection.

Adults: 100-150 mg per day in 2-3 divided doses.

Children: 1-3 mg/kg body weight per day in divided doses.

Mode of Action

Inhibits prostaglandin synthesis. It accumulates in the synovial fluid.

Uses

To manage postoperative pain, musculoskeletal pain, temporomandibular joint pain.

Contraindications

No specific contraindications. However caution needs to taken while prescribing diclofenac sodium to patients with chronic hepatic or renal dysfunction.

Side Effects

Nausea, headache, dizziness, rashes and epigastric pain.

Added note: Diclofenac sodium increase peptic ulcer bleeding.

It may minimize the effects of antihypertensive and antidiuretic drugs.

Care needs to be taken while prescribing the drug to patients who are allergic to aspirin.

Name of the Drug : Aspirin

It is a salicylate (acetylsalicylic acid). It has analgesic, antipyretic and anti-inflammatory properties. It also reduces platelet aggregation.

Available forms and Dosage

Oral preparations: Tablets.

50 mg, 75 mg, 100 mg, 150 mg, 325 mg and 400 mg .

Adults: 300-500 mg three times per day (analgesic/antipyretic).

75-150 mg per day (antiplatelet effect).

Children: 30-65 mg per kg body weight per day in divided doses.

Mode of Action

It prevents prostaglandin synthesis by cyclo oxygenase pathway. It inhibits thromboxane A_2 formation in platelets thereby reducing platelet aggregation.

Uses

Oro dental pain, Myalgia, osteoarthritis.

Contraindications

Hypersensitivity, Gastro intestinal bleeding, Asthma and Hemophilia.

Side Effects

Skin rashes, Indigestion, ringing in the ears, breathlessness, wheezing, nausea, vomiting, epigastric distress, increased bleeding time, Reye's syndrome and patients with pre existing lesions may have cerebral hemorrhage.

Added note: Aspirin should not be given with anticoagulants as it potentiates the action of the anticoagulants causing abnormal bleeding.

Name of the Drug: Piroxicam

It is an oxicam derivative and has analgesic, antipyretic and anti-inflammatory properties.

Available forms and Dosage

Oral preparations: Tablets, dispersible tablets, capsules.

Parenteral preparations: 20 mg/ ml injection available in 1 and 2 ml ampoules.

Adults: 20 mg two per day for the first two days followed by 20 mg one per day.

Children: for over 6 years of age.

Less than 15 kgs, 5 mg one per day.

15 to 25 kgs, 10 mg one per day.

26 to 45 kgs, 15 mg one per day.

Mode of the Action

Inhibits the cyclooxygenase pathway of prostaglandin synthesis.

Uses

It is used as a short term analgesic and a long term anti-inflammatory drug.

Used in the management of musculoskeletal injuries, rheumatoid and osteoarthritis.

Contraindications

Contraindicated for use in patients with renal and hepatic impairment. Not recommended in patients suffering from cardiovascular diseases and hemorrhagic disorders.

Side Effects

Nausea, anorexia and heart burn. Minimal blood loss through faeces. Skin rashes and pruritis are seen in some patients.

Added note: It is not recommended for children below 6 years of age.

Name of the Drug: Ketorolac

It is a Pyrrolo-Pyrrole derivative. It has a potent analgesic and moderate anti-inflammatory activity.

Available Forms and Dosage

Oral preparations: Tablets

10 mg tablets.

Parenteral preparations: Intramuscular injection.

30 mg/ ml, 1 ml ampoule.

Adults: Initially 20 mg followed by 10 mg every 4-6 hourly.

Upto a maximum dose of 40 mg/day.

Injection: 30-60 mg IM, followed by 10-30 mg every 4-6 hourly.
Upto a maximum of 60 mg per day.

Mode of Action

It inhibits prostaglandin synthesis and said to relieve pain by a peripheral mechanism.

Platelet aggregation is inhibited for short durations.

Uses

It is used to relieve acute musculoskeletal pain, migraine and post operative pain.

Contraindications

It should not be given to patients who are on anticoagulants. The safety of Ketorolac has not been studied in pregnant women, children, old patients and patients with gastric ulcers, cardiac, renal and hepatic failure. Should be used in patients who report hypersensitivity to aspirin.

Side Effects

Nausea, Abdominal pain and discomfort, indigestion, ulcerations, loose stools, dizziness, Palpitations, Stevens Johnson syndrome, and acute renal failure. Pruritis and pain at the site of injection.

Added note: Ketorolac should not be used continuously for more than 5 days.

Name of the Drug: Nimesulide (Sulfonanilide derivative)

It has anti-inflammatory, antipyretic and analgesic actions.

Available forms and Dosage

Oral preparations: Tablets (50 mg, 100 mg, 200 mg), Dispersible tablets (50 mg, 100 mg), Kids tablets (50 mg, 100 mg), Suspensions 50 ml and 60 ml (50 mg/5 ml) and Pediatric drops 15 ml (50 mg/5 ml).

Adults: 100 mg two times per day.

Children: 5 mg per kg body weight per day in 2-3 divided doses.

Mode of Action

It inhibits prostaglandin synthesis. It leads to inhibition of superoxide anion generation, inhibition of histamine release from tissue mast cells and basophils, inhibition of PAF synthesis and metalloproteinases.

Uses

Postoperative pain, pain associated with sinusitis and of dental origin and osteoarthritis.

Contraindications

Patients suffering hepatic failure and active peptic ulcers.

Side Effects

Heartburn, nausea, loose stools, skin rashes and pruritis, dizziness, headache and somnolence.

Added note: Precaution should be taken while recommending the drug to patients with congestive cardiac failure and liver cirrhosis.

Name of the Drug : Rofecoxib (1 generation selective Cox-2 inhibitor)*Available forms and Dosage*

Oral preparations: Tablets (12.5 mg, 25 mg, 50 mg) and suspensions 30 ml (12.5 mg and 25 mg).

Parenteral preparations: 25 mg/2 ml ampoule.

Adults: 50 mg per day loading dose followed by 25 or 50 mg once per day.

Mode of Action

Selectively inhibits Cyclo oxygenase –2 enzyme.

Uses

Management of acute pain.

Contraindications

Hypersensitivity

Side Effects

Nausea, diarrhea and headache.

Added note: The effects of Rofecoxib have not been studied in patients below 18 years of age and pregnant women.

Name of the Drug: Celecoxib
(I generation selective Cox-2 inhibitor)

Available forms and Dosage

Oral preparations: Capsules and tablets (100 mg and 200 mg).

Adults: 100 or 200 mg per day in a single or divided doses.

Mode of Action

Selectively inhibits Cyclo oxygenase –2 enzyme.

Uses

Management of acute pain.

Contraindications

Hypersensitivity.

Side Effects

Nausea, headache, diarrhoea, rhinitis dyspepsia and abdominal pain.

Added note: Should not be recommended in patients with liver and renal failure.

Should be avoided in the third trimester of pregnancy as it may cause premature closure of ductus arteriosus.

Name of the Drug: Valdecoxib
(II generation selective Cox-2 inhibitor)

Available forms and Dosage

Oral preparations: Available as 10 mg, 20 mg and 40 mg tablets.

Adults: 20 to 40 mg per day in divided doses.

Mode of Action

Inhibition of prostaglandin synthesis primarily through inhibition of Cyclo oxygenase –2 (COX-2).

Uses

Postoperative pain.

Contraindications

Hypersensitivity, asthma and urticaria.

Side Effects

Nausea, abdominal pain, headache, dizziness, vomiting, rhinitis and dyspepsia.

Added note: Avoided in hepatic failure, renal failure and pregnancy.

Name of the Drug : Parecoxib
(II generation selective Cox-2 inhibitor)

Available forms and Dosage

Tablets and Injections.

Oral preparations: 50 mg.

Parenteral preparations: 40 mg IM or IV.

Adults: 50 mg one per day.

40 mg IM or IV up to a maximum of 80 mg per day.

Mode of Action

It is the first selective cyclo-oxygenase-2 inhibitor for parenteral administration. Inhibits prostaglandin synthesis through inhibition of COX-2.

Uses

Short term treatment of postoperative pain.

Contraindications

Patients allergic to NSAIDs.

Hypersensitivity and advanced renal failure.

Side Effects

Hypotension, hypertension, peripheral oedema, dry socket, dyspepsia, flatulence, insomnia, respiratory insufficiency pruritis and oliguria.

Added note: Not used in patients below 18 years of age.

Parecoxib is not recommended for use in women who are attempting to conceive.

Other Cox-2 inhibitors: Other second generation Cox-2 inhibitors are Etoricoxib and Lumiracoxib.

Individual studies as of date have shown that both these drugs have a significant use in managing postoperative dental pain. Etoricoxib is said to have fewer upper gastrointestinal complications.

ANTI-INFLAMMATORY DRUGS

Name of the Drug: Serratiopeptidase (proteolytic enzyme)

Available forms and Dosage

Oral preparations: Tablets.

Available as plain serratiopeptidase and combination with diclofenac sodium, amoxycillin, nimesulide and trace elements.

Plain serratiopeptidase: (2.5 mg, 5 mg, 10 mg and 20 mg).

Combinations

Serratiopeptidase 10 mg + diclofenac 50 mg.

Serratiopeptidase 15 mg + nimesulide 100 mg.

Serratiopeptidase 10 mg + amoxycillin I.P.250 mg.

Serratiopeptidase 10 mg + cobalt, manganese, and zinc in traces (10 mg).

Adults: 10 to 30 mg per day in three divided doses after food intake.

Mode of Action

Serratiopeptidase relieves oedema associated with trauma, infection or chronic venous insufficiency.

Uses

Management of postoperative oedema, oedema associated with trauma and inflammation associated with oral and perioral structures.

Contraindications

Not recommended in patients on anticoagulants, coagulative disorders, hepatic and renal dysfunctions.

Hypersensitivity to serratiopeptidase.

Side Effects

Nausea, anorexia and abdominal discomfort.

Added note: Should be used with caution in pregnant women, children and nursing mothers.

ANTIMICROBIALS

Name of the Drug: Amoxycillin

Available forms and Dosage

Oral preparations: dispersible tablets, syrup, and capsules.

125 mg (kid tab), 250 mg, 500 mg.

Parenteral preparations: 100 mg/ ml, 125 mg/5 ml, 250 mg/5 ml and 500 mg vial.

Adults: 250-500 mg, three times a day.

Children: 20-40 mg/kg/day in three divided doses.

Mode of Action

Bactericidal, inhibits bacterial cell wall synthesis.

Uses

Oro-dental infections, actinomycosis, acute maxillary sinusitis.

Contraindications

Cannot be used in patients who are allergic to penicillin or cephalosporins.

Care to be taken in patients with chronic renal dysfunction.

Side Effects

Diarrhea, Pruritis, skin rashes, nausea, vomiting and perioral edema.

Added note: Safe in pregnancy and nursing mothers.

In order to minimize drug induced diarrhea, amoxycillin is given along with lactobacillus.

Interacts with oral contraceptives leading to the failure of the action of contraceptives.

Name of the Drug : Amoxycillin + Cloxacillin*Available forms and Dosage*

Oral preparations: dispersible tablets and capsules.

125 mg + 125 mg, 250 mg + 250 mg, 500 mg + 500 mg.

Parenteral preparations: 125 mg + 125 mg vial, 250 mg + 125 mg vial, 250 mg + 250 mg vial and 500 mg + 500 mg vial.

Adults: 250 mg-500 mg, three times a day.

Children: 20-40 mg/kg/day in three divided doses.

Name of the Drug: Amoxycillin + Clavulanic Acid*Available forms and Dosage*

Oral preparations: Tablets and 30 ml syrup and suspension.

Tablets (for adults).

Amoxycillin 250 mg + Clavulanic acid 125 mg.

Amoxycillin 500 mg + Clavulanic acid 125 mg.

Amoxycillin 500 mg + Clavulanic acid 500 mg.

Amoxycillin 250 mg + Clavulanic acid 125 mg.

Kid tablets

Amoxycillin 125 mg + Clavulanic acid 31.25 mg.

Syrup (30 ml).

Amoxycillin 125 mg + Clavulanic acid 31.25 mg per 5 ml.

Amoxycillin 250 mg + Clavulanic acid 125 mg per 5 ml.

Suspension (30 ml).

Amoxycillin 200 mg + Clavulanic acid 28.5 mg per 5 ml.

Parenteral preparations

Amoxycillin as trihydrate 1g and clavulanic acid 200 mg – 1.2g vial.

Pediatric dose:

Amoxycillin + Clavulanic acid 600 mg – IV.

Amoxycillin + Clavulanic acid 300 mg – IV.

Dosage

Adults: 1-2 tablets of amoxycillin 250 mg and clavulanic acid 125 mg three times per day.

Inject IV or deep IM 1g Amoxycillin and 0.2 g Clavulanic acid – 1 vial 6 to 8 hourly.

Name of the Drug: Erythromycin (Macrolide Antibiotic)*Available forms and Dosage*

Oral preparations: dispersible tablets and syrup.

100 mg, 125 mg, 250 mg, 333 mg, 400 mg and 500 mg.

Parenteral preparations: 100 mg/5 ml, 125 mg/5 ml, 100 mg/ ml and 250 mg/ ml vial.

Adults: 250 mg, four times per day (dosage can be increased in severe infections).

Children: 30 –50 mg/kg/day in four divided doses (dosage can be increased in severe infections).

Mode of Action

Mainly Bacteriostatic

Uses

Used as an alternate drug in patients who are allergic to penicillin.

Contraindications

Hypersensitivity.

Patients with liver disease.

Side Effects

Diarrhea, nausea, vomiting, myalgia, weakness, reversible hearing loss, cardiac arrhythmias and cholestatic jaundice.

Added note: Safe in pregnancy and nursing mothers.

Safe in patients with renal failure.

Name of the Drug: Tetracycline (Broad Spectrum Antibiotic)*Available forms and Dosage*

Oral preparations: Capsules and tablets.

250 mg and 500 mg.

Adults: 1 gm daily in 2-4 divided doses (maximum of 2 gm/day).

Children: 20 –40 mg/kg/day in 2-4 divided doses.

Mode of Action

Inhibits protein synthesis

Uses

Used in treating aphthous ulcers and periodontal diseases.

Contraindications

Hypersensitivity to tetracycline.

Patients with renal failure, Systemic lupus erythematosus.

Pregnant women and nursing mothers.

Should not be used in children less than 8 years of age.

Side Effects

Diarrhea, nausea, vomiting, Light sensitive rashes, Benign Intracranial hypertension, Pancreatitis, Pseudomembranous colitis and staining of teeth.

Added note: Tetracyclines interfere with penicillin.

Antacids impede the absorption of tetracycline.

Tetracycline tends to discolor teeth of children.

Name of the Drug: Doxycycline (Broad Spectrum Antibiotic)*Available forms and Dosage*

Oral preparations: Capsules and tablets.

50 mg and 100 mg.

Adults: First day: 100 mg 2 times/day.

Followed by 100 mg one per day.

Children: 5 mg/kg/day in 2 divided doses.

Mode of Action

Inhibits protein synthesis.

Uses

Used in treating orodental infections.

Contraindications

Hypersensitivity to tetracycline.

Patients with renal failure, Liver failure, Systemic lupus erythematosus.

Pregnant women and nursing mothers.

Should not be used in children less than 12 years of age.

Side Effects

Diarrhea, nausea, vomiting, Light sensitive rashes and staining of teeth.

Added note: Doxycycline interferes with penicillin.

Antacids impede the absorption of Doxycycline.

Doxycycline tends to discolor teeth of children.

Doxycycline may cause hepatic impairment.

Name of the Drug: Minocycline (Tetracycline Antibiotic)*Available forms and Dosage*

Oral preparations: Capsules (50 mg).

Adults: 100 mg twice daily for 5 days.

Children: for children above 8 years of age.

4 mg/kg body weight per day in 2 divided doses .

Mode of Action

Bacteriostatic, inhibits protein synthesis.

Uses

Used in treating aphthous ulcers and periodontal diseases.

Contraindications

Hypersensitivity to tetracycline.

Patients with hepatic failure.

Pregnant women and nursing mothers.

Should not be used in children less than 8 years of age.

Side Effects

Nausea, vomiting, skin rashes, pigmentations, liver damage, ataxia, vertigo and nystagmus.

Added note: Minocycline interferes with oral contraceptives and reduces their efficiency.

Antacids impede the absorption of tetracycline.

Tetracycline tends to discolor teeth of children.

Name of the Drug: Cephalixin (Broad Spectrum Antibiotic)

Cephalixin is a first generation cephalosporin, which is orally effective.

Available forms and Dosage

Oral preparations: Capsules, dry syrup, dispersible tablets and pediatric drops.

125 mg kid tablets, 250 mg, 500 mg.

Syrup and drops: 100 mg/ ml, 125 mg/5 ml, and 250 mg/5 ml.

Adults: 1-4 mg per day in equal divided doses.

Children: 25-50 mg/kg body weight per day in divided doses.

Mode of Action

All cephalosporins have a bactericidal action. They inhibit the bacterial cells wall synthesis.

Uses

Can be used as an alternate drug to penicillin. Effective against mixed aerobic anaerobic infections.

Contraindications

Not prescribed in patients with renal failure and history of bleeding disorders.

Side Effects

Drug induced diarrhea, hypersensitivity reactions, nephrotoxicity, hemorrhage and very rarely neutropenia and thrombocytopenia.

Added note:

1. May interfere with the action of oral contraceptive pills.
2. Secreted in the breast milk, caution to be taken when prescribing the drug to nursing mothers.

Name of the Drug: Metronidazole

Is exhibits a broad spectrum bactericidal activity against anaerobic organisms and protozoa.

Available forms and Dosage

Oral preparations: Tablets and suspensions.

200 mg, 400 mg tablets and 100 mg/5 ml suspension, 200 mg/5 ml suspension.

Parenteral preparations: IV infusions.

500 mg/100 ml IV infusion.

Adults: 400 mg three times a day.

Children: 30-50 mg per kg body weight per day in divided doses.

Mode of Action

Mode of action not well understood, but known to probably cause cytotoxicity by damaging the DNA. In anaerobic organisms it is said to interfere with electron transport from NADPH or other substrates.

Uses

First drug of choice for all anaerobic infections.

Ulcerative Gingivitis.

Contraindications

Has mutagenic potential therefore not to be used in the first trimester of pregnancy.

Should not be prescribed in patients with neurological diseases, chronic alcoholism and blood dyscrasias.

Side Effects

Anorexia, Nausea and metallic taste in the mouth and abdominal cramps are common. Prolonged use may cause peripheral neuropathy and seizures. Very rarely glossitis, dryness of the mouth and transient neutropenia is seen.

MUSCLE RELAXANTS

Name of the Drug : Methocarbamol (centrally acting muscle relaxant)

Available forms Dosage

Oral preparations: Tablets.

Available in combination with Ibuprofen and Paracetamol in various proportions.

Methocarbamol 750 mg + Ibuprofen 400 mg.

Methocarbamol 750 mg + Ibuprofen 200 mg.

Methocarbamol 350 mg + Paracetamol 250 mg.

Parenteral preparation: Intravenous or Intramuscular injection.

Available as 100 mg/10 ml injection.

Adults:

Oral: 500 mg to 1500 mg, 4-6 hourly.

Parenteral: 100-200 mg, 6 hourly.

Children: (for tetanus) 15 mg per kg body weight repeated every 6 hours.

Mode of Action

It selectively depresses spinal and supraspinal polysynaptic reflexes involved in the regulation of muscle tone. All centrally active muscle relaxants have a mild sedating effect.

Uses

To manage skeletal muscle spasms, Tetanus.

Contraindications

Hypersensitivity, cerebral damage, epilepsy and myasthenia gravis.

Side Effects

Fever, Nausea, Anorexia, skin rashes, drowsiness, headache, bradycardia, hypotension, restlessness and anxiety.

Added note: Should not be prescribed to patients under the age of 12, except to manage tetanus.

The dose of methocarbamol to be reduced in patients with hepatic or renal failure.

Name of the Drug: Chlorzoxazone (centrally acting muscle relaxant)

Available forms and Dosage

Oral preparations: available as tablets. However, chlorzoxazone is commercially available in combination with paracetamol, ibuprofen and diclofenac sodium.

Chlorzoxazone 250 mg + paracetamol 300 mg.

Chlorzoxazone 500 mg + paracetamol 300 mg + diclofenac sodium 50 mg.

Chlorzoxazone 500 mg + paracetamol 500 mg + diclofenac sodium 50 mg.

Chlorzoxazone 250 mg + paracetamol 325 mg + diclofenac sodium 50 mg.

Adults: 250 mg to 750 mg three times per day.

Children: 125 to 500 mg three times per day.

Mode of Action

It acts on the subcortical and spinal level to inhibit multisynaptic areas.

Uses

Management of spasms of the skeletal muscles.

Contraindications

Hypersensitivity.

Side Effects

Nausea, gastric irritation, headache, skin rashes, irritability and angioedema.

Added note: Alcohol to be avoided during the prescribed period.

The drug should be stopped if liver dysfunction is seen.

CORTICOSTEROIDS

Name of the Drug: Betamethasone

Available forms and Dosage

Oral preparations: Tablets.

0.5 mg and 1 mg.

Parenteral preparations: Injections for Intravenous, Intramuscular and Intraoral (submucosal/intralesional) use.

Adults:

Oral: 0.5 to 5 mg per day in divided doses.

Parenteral: 4 to 20 mg IV infusion or Intramuscular injection 3 to 4 times per day.

Children:

Up to 1 year- 1 mg intravenous.

1-5 years: 2 mg; 6 to 12 years- 4 mg IV or IM.

Mode of Action

It suppresses inflammation and immune response through glucocorticoid receptors in the nucleus.

Uses

Acute allergic reactions, Oral Lichen planus (systemic administration of betamethasone), Oral submucous fibrosis (intralesional administration).

Contraindications

Systemic infections and live virus vaccination.

Side Effects

Muscle weakness, indigestion, weight gain, bloody or black colored stools and mood swings.

Added note: Betamethasone should not be withdrawn suddenly after using for prolonged use; the drug dose should be tapered.

Caution should be taken while recommending the drug to patients with cardiac diseases, glaucoma, high blood pressure, peptic ulcer and infections.

Name of the Drug : Triamcinolone

Available forms and Dosage

Oral preparations: Tablets, oral paste for topical application.

4 mg tablets, 5 gm (tube for oral application).

Parenteral preparations: Intradermal, Intrarticular and deep intramuscular injections.

10 mg/ ml and 40 mg/ ml (1 ml vial).

Adults: for adults and children above the age of 12 years.

Oral: 8-32 mg per day in single or divided doses.

Parenteral:

Intraarticular- 2.5 mg-15 mg.

Intradermal-1-3 mg.

Deep intramuscular- 40-60 mg.

Children: for ages between 6 to 12 years.

4 to 12 mg per day in divided doses, up to a maximum of 40 mg.

Mode of Action

It is a potent synthetic glucocorticoid.

Uses

Allergic reactions, treatment of arthritis employing intraarticular injection of triamcinolone, synovitis, oral lichens planus and primary treatment for acute asthmatic attacks.

Contraindications

Hypersensitivity and systemic fungal infection.

Side Effects

Throat irritation, coughing, hoarseness of voice, laryngeal and pharyngeal fungal infections.

Added note: This drug should not be discontinued abruptly.

Not recommended for children below 6 years of age.

Name of the Drug: Prednisolone (Glucocorticoid)*Available forms and Dosage*

Oral preparations: Tablets.

5 mg, 10 mg and 20 mg.

Parenteral preparations: Intramuscular and Intravenous injections.

Available in the form of Plain prednisolone, Methyl prednisolone acetate and methylprednisolone sodium succinate.

40 mg/ ml, 80 mg/2 ml, 125 mg, 500 mg, 1 gm (vial) .

Adults:

Oral: 10-60 mg/day

Parenteral: Methylprednisolone acetate–Intramuscular/Intralesional/ intraarticular–40 mg/ ml.

Methyl prednisolone sodium succinate–(slow intravenous)–10-40 mg.

Children:

Oral: 1-2 mg per kg body weight in divided doses per day.

Parenteral: 0.5 mg per kg body weight per day.

Mode of Action

Prednisolone is a natural short acting glucocorticoid with mineralocorticoid activity.

Uses

Autoimmune conditions, allergic conditions and inflammatory diseases.

Contraindications

Hypersensitivity, Live virus vaccination and systemic infections.

Side Effects

Weight gain, indigestion, muscle weakness, mood swings.

Added note: Not recommended in patients with liver and heart failure. Precaution should be exercised while prescribing the drug to patients with peptic ulcer, glaucoma, diabetes and osteoporosis.

ANTIFUNGAL AGENTS**Name of the Drug: Nystatin (polyene antifungal agent)***Available forms and Dosage*

Oral preparations: Available as tablets that can be chewed and sucked upon or powdered and mixed with a suitable vehicle like glycerine and applied topically over the lesion.

Adults: 5 to 10 lac units, 3 to 4 times per day.

For topical application on the oral mucous membrane these tablets can be powdered and mixed with a vehicle like glycerine.

Mode of Action

It binds to sterols in the fungal cell membrane, altering membrane permeability, producing leakage of intracellular components, and resulting in fungal cell death.

Uses

Drug of choice for treatment of localized oral candidosis. Nystatin is not indicated for treatment of systemic candidal infections.

Contraindications

History of hypersensitivity to nystatin.

Side Effects

Side effects are minimal because systemic and gastrointestinal absorption of nystatin from the skin or oral mucous membranes is negligible.

Added note: Not to be used in patients with renal and hepatic failure.

Name of the Drug: Clotrimazole (imidazole antifungal agent)*Available forms and Dosage*

Oral preparations: It is available as a solution in a 15 ml bottle.

Parenteral preparations: The solution is applied with a cotton pellet 3 or 4 times a day over the affected site. 30 minutes prior to food intake.

Mode of Action

It decreases fungal growth by inhibiting the synthesis of ergosterol and increasing the permeability of the cell membrane.

Uses

Management of localized candidosis of the perioral skin and mucous membranes.

Clotrimazole is indicated for antifungal prophylaxis in patients who are immunocompromised because of chemotherapy, radiation, and long-term corticosteroid use.

Contraindications

Contraindicated for patients with a prior history of hypersensitivity or adverse reaction to clotrimazole.

Clotrimazole is not indicated for systemic infection.

Side Effects

Nausea or vomiting and elevation of liver enzymes.

Unpleasant sensation in the mouth.

Added note: Clotrimazole may increase the risk of hypoglycemia.

**Name of the Drug: Ketoconazole
(synthetic imidazole antifungal agent)***Available forms and Dosage*

Oral preparations: Tablets, available as 200 mg.

Adults: 200 to 400 mg once daily after meals.

Children: for children over 2 years of age.

5-10 mg per kg body weight per day, once daily.

Mode of Action

Ketoconazole blocks ergosterol synthesis in the fungal cell membrane, resulting in altered permeability and decreased fungal growth.

Uses

Used for treating systemic oral and chronic mucocutaneous candidiasis, histoplasmosis, coccidiomycosis and other fungal diseases.

Contraindications

Contraindicated for patients with a prior history of hypersensitivity or adverse reaction to ketoconazole and patients with hepatic disease.

Should not be given to pregnant women and nursing mothers.

Side Effects

Nausea, vomiting, and abdominal pain, thrombocytopenia, pruritis, headache, decreased libido, menstrual irregularities, and gynecomastia. Prolonged use might cause yellow discoloration of the skin.

Added note: Patient is advised to avoid alcohol (Disulfiram reaction).

Not recommended in patients with renal failure.

Antifungal therapy is continued for 1 to 2 weeks or until clinical signs are resolved.

Name of the Drug: Fluconazole
(synthetic triazole antifungal agent)

Available forms and Dosage

Oral preparations: capsules and tablets

50 mg, 100 mg, 150 mg and 200 mg.

Parenteral preparations: available as 100 ml infusion (2 mg/ ml).

Adults: The loading dose is 200 mg and then 100 mg is taken daily for 14 days.

Children: for children older than 4 weeks

6 mg/kg body weight per day followed by 3 mg per kg body weight per day.

Mode of Action

Inhibits fungal cytochrome P450 sterol C- 14 alpha, demethylation which is an essential step in the synthesis of fungal cell wall membranes.

Uses

For serious oral candidosis, systemic candidal infection, cryptococcal meningitis.

Contraindications

Should not be used in patients below one month of age.

Contraindicated in nursing mothers and pregnant women.

Side Effects

Angioedema and Anaphylaxis may occur in some patients.

Nausea, vomiting, and abdominal pain.

Headache and skin rashes.

Stevens-Johnson syndrome is rarely seen.

Added note: Should be used with caution in patients with renal and hepatic diseases.

Patient is asked to report any signs and symptoms of liver complications such as jaundice, dark urine, pale stools, extreme fatigue, anorexia, nausea, and vomiting.

ANTI VIRAL DRUGS**Name of the Drug: Acyclovir
(deoxiguanosine analogue antiviral drug)***Available forms and Dosage*

Oral preparations: Tablets, dispersible tablets.

200 mg, 250 mg, 400 mg, 500 mg and 800 mg.

Parenteral preparations: for intravenous infusion.

Available as 250 mg/5 ml.

Adults:

For herpes simplex infections: 200 mg five times per day for 5 days.

For herpes zoster infections: 800 mg 5 times daily for 7 days.

Children:

For herpes simplex infections: 5 mg per kg body weight per dose every weight hours for 7 days.

In newborn children: Intravenous infusion of 10 mg per kg body weight every 8 hours for 10 to 14 days as per the requirement.

Mode of Action

Acyclovir inhibits viral duplication by interacting with the viral DNA polymerase. Herpes simplex I is most sensitive followed by Herpes simplex II and Herpes Zoster virus (Ebstein-Barr virus).

Acyclovir has practically no action against Cytomegalovirus.

Uses

Management of mucocutaneous herpes simplex and herpes zoster infections.

Contraindications

Hypersensitivity, glaucoma, patients with previous history of psychiatric illness.

Not recommended in pregnant women and nursing mothers (acyclovir may reduce lactation).

Side Effects

Renal dysfunction, burning sensation, rashes, nausea, vomiting and headache. May cause an increase in nephrotoxicity when given along with other nephrotoxic agents.

Added note: Some patients may complain of joint pains.

Higher doses of acyclovir may cause neurological manifestations, which are reversible such as disorientations, hallucinations, convulsions and tremors.

ANTIANXIETY DRUGS**Name of the Drug: Diazepam (Benzodiazepine)***Available forms and Dosage*

Oral preparations: Tablets and Syrup.

Tablets (2 mg, 5 mg and 10 mg).

Syrup 60 ml (2 mg/5 ml).

Parenteral preparations: Intravenous 2 ml injection (5 mg/ml).

Adults:

Oral: 2 to 10 mg twice a day or 5 mg –10 mg one at a bed time.

Parenteral: 10 to 20 mg IV at the rate of 1 mg per minute.

Children: 0.1 to 0.3 mg per kg body weight per day.

Mode of Action

Diazepam acts on GABA receptor complex in the limbic system, hypothalamus and thalamus to potentiate Gamma amino butyric acid to produce sedation and muscle relaxant effect.

Uses

Anxiety, bruxism and preoperative use for managing patient's behavior.

Contraindications

Hypersensitivity, patients with respiratory distress, and acute narrow angle glaucoma.

Side Effects

Physical or psychological dependence, drowsiness, fatigue, ataxia, confusion, constipation, diplopia, depression, change in libido, blurred vision and slurred speech.

Added note: No recommended in patients with cardiac, liver and renal failures.

Name of the Drug: Alprazolam (Benzodiazepine)*Available forms and Dosage*

Oral preparations: Tablets.

0.25 mg, 0.5 mg, 0.75 mg, 1 mg and 1.5 mg.

Adults: 0.25 mg to 0.5 mg twice a day.

Geriatric patients: 0.25 mg twice a day.

Mode of Action

Acts on GABA receptor complex in the limbic system, hypothalamus and thalamus to potentiate Gamma amino butyric acid to produce sedation and muscle relaxant effect.

Uses

Anxiety associated with depression, Bruxism.

Contraindications

Myasthenia gravis, Hypersensitivity and acute narrow angle glaucoma.

Side Effects

Blood dyscrasias, Anorexia, nausea, pruritis, loss of co-ordination, slurred speech, and weakness.

Added note: Should not be prescribed to patients with epilepsy, hepatic and renal diseases.

Not recommended for use in children, pregnant women and nursing mothers.

TRICYCLIC ANTIDEPRESSANTS**Name of the Drug: Amitriptyline
(Noradrenaline and Serotonin reuptake inhibitor)***Available forms and Dosage*

Oral preparations: Tablets (10 mg, 25 mg, 50 mg and 75 mg).

Parenteral preparations: 1 ml ampoule (10 mg).

Adults: Initially 75 mg per day and gradually increased to 150 mg per day in divided doses.

Mode of Action

Amitriptyline blocks the neuronal uptake of noradrenaline and serotonin. Has anticholinergic and sedative action.

Uses

Management of chronic pain (post herpetic neuralgia).

Contraindications

Hypersensitivity, cardiovascular insufficiency urine retention, lung diseases, and Ischaemic heart disease. Not recommended in pregnant women and nursing mothers.

Side Effects

Thrombocytopenia, postural hypotension, ventricular fibrillation, agranulocytosis, dry mouth, difficulty in passing urine, drowsiness, palpitations, arrhythmias, tremors, sweating, blurred vision, headache, constipation, confusion and delirium, weight gain and sexual disturbances.

Added note: Not recommended in alcoholics. During the initial phase of

treatment excessive sedation may occur.

**Name of the Drug: Doxepin
(Noradrenaline and Serotonin reuptake inhibitor)**

Available forms and Dosage

Oral preparations: Tablets and Capsules (10 mg, 25 mg and 75 mg).

Adults: 75 to 100 mg per day in three to four divided doses.

Mode of Action

It inhibits the activity of histamine, 5-HT and acetylcholine. It also interferes with the transport, release and storage of catecholamines.

Uses

Management of chronic pain (postherpetic neuralgia).

Contraindications

Hypersensitivity, epilepsy, glaucoma, hepatic dysfunction and retention of urine.

Side Effects

Dry mouth, nausea, tachycardia, blurred vision, skin rashes, constipation, epigastric pain, jaundice and cardiac arrhythmias.

Added note: Not recommended in pregnant women, patients with hypertension, cardiovascular diseases and elderly patients.

**Name of the Drug: Nortriptyline
(Noradrenaline reuptake inhibitors)**

Available forms and Dosage

Oral preparations: Tablets (25 mg).

Adults: 50 to 150 mg in divided doses.

Children:

For children aged between 8 to 11 years: 10-20 mg per day in single or divided doses.

Children older than 11 years: 25 to 35 mg per day, given at bedtime along with meals (minimizes gastrointestinal irritation). The use of Nortriptyline should not exceed 3 months.

Mode of Action

It inhibits the activity of histamine, 5-HT and acetylcholine. It also interferes with the transport, release and storage of catecholamines.

Uses

Management of chronic pain (post herpetic neuralgia).

Contraindications

Not recommended in nursing mothers and pregnant women. Patients with epilepsy, urinary retention and narrow angle glaucoma should not be prescribed nortriptyline.

Side Effects

Dry mouth, nausea, tachycardia, blurred vision, skin rashes, constipation, epigastric pain, jaundice and cardiac arrhythmias.

Added note: Should not be prescribed to chronic alcoholics.

Contraindicated in children below 8 years of age.

MISCELLANEOUS DRUGS**Name of the Drug: Carbamazepine***Available forms and Dosage*

Oral preparations: tablets (100 mg, 200 mg and 400 mg); syrup 100 ml (100 mg/5 ml).

Adults: 100 to 200 mg per day; once or twice per day.

Subsequently increased to 800 to 1200 mg per day as per the requirement.

Up to a maximum of 1600 mg per day.

Children: (in divided doses).

Children less than 1 year: 100-200 mg per day.

1-5 years: 200 mg-400 mg per day.

6 to 10 years: 400 to 600 mg per day.

11 to 15 year olds: 600 to 1000 mg per day.

Mode of Action

Carbamazepine minimizes polysynaptic responses and blocks post-tetanic potentiation. Used effectively to reduce pain in trigeminal neuralgia, postherpetic neuralgia and glossopharyngeal neuralgia. It appears to

decrease conductance in the sodium channels and inhibit ectopic discharges (however pain returns back with the discontinuation of this drug).

Uses

Use to manage pain associated with trigeminal neuralgia, postherpetic neuralgia and glossopharyngeal neuralgia.

Contraindications

Hypersensitivity, Bone marrow depression, Porphyria, long standing hepatic or renal impairment.

Side Effects

Dizziness, drowsiness, loss of appetite, blurred vision, skin rashes and on prolonged use ankles may become swollen.

Added note: Carbamazepine may interfere with the action of oral contraceptives.

It reduces the anticoagulant activity.

Alcohol intake may increase the sedative effect of carbamazepine.

Name of the Drug : Gabapentin (newer antiepileptic drug)

It is a lipophilic GABA (Gamma Amino Butyric Acid) derivative, which crosses to the brain and enhances the release of GABA.

Available forms and Dosage

Oral preparations: Capsules; 300 mg and 400 mg.

Adults: initially 300 mg once a day followed by 300-600 mg thrice a day as per requirement.

Up to a maximum of 2.4 gm per day in three divided doses.

Mode of Action

It enhances GABA release.

Uses

Management of trigeminal neuralgia.

Contraindications

Hypersensitivity. Not recommended in pregnant women. Should be used with precaution in patients with cardiac, renal and hepatic failures. Not indicated for use in children.

Side Effects

Dizziness, ataxia, fatigue, headache, tremors, diplopia, vomiting, nausea and rhinitis.

Added note: Alcohol intake along with Gabapentin may cause CNS depression. The dosage of the drug should be gradually tapered and should not be withdrawn abruptly. It causes an increase in phenytoin levels, hence used as an adjunct in the treatment of partial seizures.

Name of the Drug : Baclofen (GABA derivative)

Available forms and Dosage

Oral preparations: Tablets (10 mg and 25 mg).

Adults: Initially 15 mg per day.

Maintenance dose of 30 to 75 mg per day in divided doses.

Children: 0.75 to 2 mg per kg body weight per day in divided doses.

Mode of Action

It seems to inhibit monosynaptic and polysynaptic reflex transmission at the spinal level.

Uses

Management of trigeminal neuralgia.

Contraindications

Hypersensitivity, peptic ulcers, chronic hepatic or renal dysfunctions. Not recommended in children, pregnant women and nursing mothers.

Side Effects

Nausea, headache, dizziness, muscle weakness, hypotension, palpitations, syncope, increased frequency of urination, anorexia, dry mouth, altered taste sensation, constipation or diarrhea.

Added note: Avoid abrupt withdrawal of the drug. It should be gradually stopped by tapering the dose.

It increases the action of antihypertensives.

Should be cautiously used in patients suffering from Diabetes Mellitus.

Name of the Drug: Levamisole (antihelminthic, used as an immunomodulator)*Available forms and Dosage*

Oral preparations: tablets and syrup.

Tablets (50 mg and 150 mg).

10 ml syrup (50 mg/5 ml).

Adults: 150 mg single dose. If required, repeat the dose after 7 days.

Children: 3-5 mg per kg body weight as a single dose.

Mode of Action

It used as an immunomodulator. It restores the depressed T cell function.

Uses

Used in the management of recurrent minor/major aphthous ulcers.

Contraindications

Hypersensitivity, renal diseases, hepatic disease, blood dyscrasias. Contraindicated in pregnant women and nursing mothers.

Side Effects

Epigastric discomfort, nausea, insomnia, dizziness, weakness and agranulocytosis on continued use.

Added note: Should not be used in patients suffering from rheumatoid arthritis.

Increases the action of oral anticoagulants.

Name of the Drug : Pilocarpine*Available forms and Dosage*

Oral preparations: Tablets.

Adults: Initially 2.5 mg to 5 mg three times daily, and for patients who don't respond adequately, titrations up to 30 mg per day at variable dosage intervals may be considered.

Mode of Action

It is a parasympathomimetic drug. It has a predominantly muscarinic-cholinergic action. It is known to stimulate lacrimal, salivary, gastric, intestinal, respiratory and pancreatic secretions.

Uses

To stimulate salivary secretion in patients with salivary gland dysfunction secondary to drug induced and radiation induced xerostomia.

Contraindications

Contraindicated in patients who are known to be hypersensitive to pilocarpine.

It should be used with caution in patients suffering from cardiovascular diseases, urinary tract obstruction, narrow angle glaucoma and Parkinson's disease.

Side Effects

Blurred vision, miosis, headache, diaphoresis and polyuria. In the case of an overdose the common signs and symptoms are bronchospasm, bradycardia, involuntary urination, hypotension, vomiting and tremors. *Added note:* Since the drug may limit night vision patients should be made aware of the effects of the drug especially if performing task like working in dimly lit environments and night driving.

Name of the Drug: Salivary Substitute*Available forms and Dosage*

Oral preparations: Commercially available in 200 ml bottles.

Composition of the salivary substitute.

30% Glycerine.

0.5% Sodium carboxy methyl cellulose.

Adults: About 20 ml of the solution used as and when required (SOS).

Mode of Action

Helps in rehydrating the oral mucosa.

Uses

Used in patients suffering from xerostomia.

Contraindications

None

Side Effects

None reported

TOPICAL AGENTS FOR INTRAORAL USE

1. Benzocaine 20% w/w
Availability: 15 gm ointment tube
Mode of action: surface anesthetic
Uses: oral ulcers, erosive lesions of the mouth causing burning sensation
Directions for use: to be applied topically over the affected region 5 minutes before intake of meals or to be used as and when required.
2. Lignocaine Hydrochloride 2% w/w
Choline salicylate 8.7% w/w
Benzalkonium chloride 0.01% w/w
Availability: 15 gm oral gel
Mode of action: surface anesthetic
Uses: oral ulcers, erosive lesions of the mouth causing burning sensation
Directions for use: to be applied topically over the affected region 5 minutes before intake of meals or to be used as and when required.
3. Chlorhexidine Gluconate 1%w/w
Availability: 15 gm ointment tube
Mode of action: surface anesthetic
Uses: oral ulcers, stomatitis
Directions for use: to be applied topically over the affected region 5 minutes before intake of meals or to be used as and when required.
4. Metronidazole benzoate I.P. equivalent to metronidazole 10 mg
Chlorhexidine gluconate solution 0.25% w/w
Available as 20 gm gel
Uses: local management of gingival and peridontontal inflammatory conditions.

DESENSITISING TOOTH PASTES

1. Strontium Chloride 10% w/w
Availability: 50 gm and 100gm paste
Mode of action: seals open dentinal tubules

Uses: dentinal hypersensitivity secondary to wasting diseases

Directions for use: to be used atleast twice daily in place of the regular tooth paste for about 3-4 weeks.

2. Potassium Nitrate 5% w/w, sodium monofluorophosphate 0.7% w/w

Availability: 50 gm and 100 gm paste

Mode of action: seals open dentinal tubules

Uses: dentinal hypersensitivity secondary to wasting diseases

Directions for use: to be used atleast twice daily in place of the regular tooth paste for about 3-4 weeks.

MOUTH WASHES

1. CHLORHEXIDINE

Sodium benzoate 2.0% w/v, alcohol 7.5% v/v. chlorhexidine gluconate solution 0. 12% v/v

Availability: 150 ml mouth wash

Uses: Aphthous ulcers, pharyngitis, laryngitis, tonsillitis, gingivitis and periodontitis

Directions for use: 10 ml of concentrated solution is swished twice daily for 2 weeks

5 ml of solution is diluted with 5 ml of water and swished 4 times a day or as and when required.

2. Potassium Nitrate 3% w/v, Sodium fluoride 0.2% w/v

Availability: 100 ml and 200 ml mouth wash

Uses: Dentinal hypersensitivity

Directions for use: 10 ml of concentrated solution is swished twice daily for 2 weeks.

NORMAL LABORATORY VALUES

1. Haematology

<i>Test</i>	<i>Normal level</i>
Red Blood Cell count millions/cu. mm. of blood (million cells per cubic millimeter)	Adult males: 5.5 Adult females: 4.8. 11-15 years: 4.8 2-10 years: 4.6-4.7 1 year: 6.1 to 4.5 (numbers decrease as child grows)
White Blood Cell Count (Total count; TC)	Adults: 5,000 to 10,000 8-18 years: 4,500 to 15,000

Contd...

Contd...

<i>Test</i>	<i>Normal level</i>
cells/cu. mm. of blood	4-7 years: 6,000 to 13,500 Infants: 8,000 to 16,500
Differential count (DC) cells/cu. mm of blood	Neutrophils: 3000-5800 or 54-62% Lymphocytes: 1500-3000 or 25-33%. Eosinophils: 50-250 or 1-3% Monocytes: 285-500 or 3-7% Basophils: 15-50 or 0-0.75% 1,50,000 to 4,00,000
Platelet count per cu. mm. of blood	
Haemoglobin (Hb) (g/dl)	Males: 15.5 +/- 2.5
grams/deci liter	Females: 14 +/- 2.5
Packed cell volume (PCV)	Males: 40-54
packed cells per100 ml	Females: 37-47
Erythrocyte sedimentation rate (ESR) calculated for 1 hour (Wintrobe method)	Males: 0-6.5 mm Females: 0-15 mm
Bleeding time (BT)	Duke's method: Less than 5 minutes
Clotting time (CT)	Capillary tube method: 1-7 minutes Lee and White method: 5-10 minutes
Prothrombin time	Quick method: 10-20 seconds
Partial thromboplastin time	24-40 seconds
Fibrinogen (mg/dl)	150-450

SERUM / URINE / SALIVARY BIOCHEMISTRY

<i>Test</i>	<i>Normal level</i>
Blood Glucose level (mg/ dl) milligrams /deci liter	Random Blood Sugar level (RBS) 80-120 Fasting Blood Sugar level (FBS) 60-100 Postprandial Blood Sugar level (PPBS) 75-135
Serum Alkaline Phosphatase	Adults: 1.5-5 <i>Bodansky units</i> Adult: 5-10 <i>King Angstrom units</i> Children: 5-14 <i>Bodansky units</i> Children: 15-20 <i>King Angstrom units</i>
Serum Calcium (Total) mg/dl	9-11
Serum Creatinine (mg/dl)	0.9-1.5
S.G.O.T. Units/ml	8-40
S.G.P.T. Units/ml	5-35
Serum Protein (total) grams/deci liter (gm/dl)	6-8
Serum Bilirubin (direct) milligrams/deci liter (mg/dl)	0- 0.2

Contd...



Contd...

<i>Test</i>	<i>Normal level</i>
Serum Bilirubin (total) milligrams/deciliter (mg/dl)	0.2- 1
Serum Uric Acid (mg/dl)	1.6- 7
Salivary Amylase (units/liter)	5- 125
Albumin –Globulin ratio	1.5-2.5: 1

Section 2—Radiology

RADIOLUCENT AND RADIOPAQUE IMAGES

A radiographic image appears as black (radiolucent) and white (radiopaque) images depending on the density of the object that has been radiographed. The radiographic appearance will also have varying degree of gray shade. A radiolucent image is produced due to lack of density of the object, allowing the X-ray beam to pass without any attenuation. A radiopaque image is produced by dense structures, which absorbs or resists the passage of the X-ray beam. Hence for identifying the disease process through radiographic investigations knowledge of the radiolucent and radiopaque images play an important role.

CLASSIFICATION

Lesions involving the maxilla and mandible can have various radiographic appearances. They can appear:

1. Radiolucent
2. Mixed radiopaque-radiolucent
3. Radiopaque

RADIOLUCENT LESIONS

Associated with teeth

Periapical radiolucencies
Pericoronal radiolucencies

Not associated with teeth

Solitary cyst like radiolucency
Multilocular radiolucencies
Solitary ill-defined radiolucency
Multiple separate radiolucencies
Generalized rarefactions

RADIOLUCENT AND RADIOPAQUE (MIXED LESIONS)

Associated with teeth

Periapical region
Pericoronal region

Not associated with teeth

RADIOPAQUE LESIONS

Associated with teeth

Periapical region

Not associated with teeth

Solitary radiopacity

Multiple separate radiopacities

Generalised radiopacity

RADIOLUCENT LESIONS

Tooth associated periapical radiolucencies

Associated with non-vital teeth

Endodontically treated

Apical scar

Surgical defect

Endodontically un-treated

Apical periodontitis

Periapical abscess

Periapical granuloma

Periapical cyst

Osteomyelitis

Associated with vital teeth

Periodontal disease

Periapical cemental dysplasia

Traumatic bone cyst

Dentigerous cyst

Non-radicular cysts

Malignant tumours

Tooth associated pericoronal radiolucencies

Pericoronal/follicular space

Dentigerous cyst

Mural ameloblastoma

Ameloblastoma

Calcifying epithelial odontogenic cyst

Adenoameloblastoma

Ameloblastic fibroma

RADIOLUCENT LESIONS

Radiolucencies not associated with teeth

<i>Solitary</i>	<i>Multilocular</i>	<i>Solitary ill-defined</i>	<i>Multiple, separate well defined</i>	<i>Generalised rarefactions</i>
Residual cyst	Residual cyst	Chronic osteitis	Multiple cysts/ granulomas	Osteoporosis
Traumatic bone cyst	Dentigerous cyst	Chronic osteomyelitis	Basal cell nevus syndrome	Osteomalacia
Primordial cyst	Primordial cyst	Squamous cell carcinoma	Multiple myeloma	Hyper-parathyroidism
Stafne's cyst	Odontogenic keratocyst	Fibrous displasia (early stage)	Metastatic carcinoma	Leukemia
Odontogenic keratocyst	Ameloblastoma	Osteosarcoma (osteolytic type)	Langerhans cell disease	Paget's disease
Hematopoietic defect	Central giant cell granuloma	Metastatic tumor	—	—
Surgical defect	Central hemangioma			
Giant cell lesion	Odontogenic myxoma			
Lateral periodontitis	Cherubism			
Ameloblastoma	Aneurysmal bone cyst			

MIXED RADIOLUCENT –RADIOPAQUE LESIONS

Associated with teeth		Not associated with teeth
<i>Periapical</i>	<i>Pericoronal</i>	
Rarefying osteitis	Odontoma (intermediate stage)	Postsurgical bone defect (healing stage)
Periapical cementoma	Adenomatoid odontogenic tumor	Chronic osteomyelitis
Periapical cementoma (intermediate stage)	Calcifying epithelial odontogenic cyst	Garre's osteomyelitis
Cementifying/ossifying	Ameloblastic fibro-odontoma	Osteoradionecrosis

Contd...

Contd...

*Periapical**Pericoronal*Fibroma
odontomaOdontogenic fibroma
Calcifying epithelial
Odontogenic tumorFibrous dysplasia
Osteosarcoma
Cementifying/ossifying fibroma
Chondroma /chondrosarcoma**RADIOPAQUE LESIONS OF THE JAW**

<i>Periapical radiopacities</i>	<i>Solitary radiopacity not contacting teeth</i>	<i>Multiple separate radiopacities</i>	<i>Generalised radiopacities</i>
Condensing osteitis	Tori, exostosis	Tori and exostoses	Florid cemento osseous dysplasia
Focal cemento osseous dysplasia	Impacted or supernumerary teeth	Multiple Retained roots	Hypercementosis
Retained root	Multiple socket sclerosis	Osteopetrosis	Paget's disease (mature stage)
Foreign bodies (extruding gutta-percha Silver points, retrograde Amalgam restorations)	Idiopathic osteosclerosis and enostosis	Multiple impacted teeth	
	Mature odontome Ectopic calcifications (such as sialolith, rhinolith)	Cleidocranial dysplasia proliferative periostitis	

RADIOGRAPHIC PRESENTATION OF BONE LESIONS AFFECTING THE MAXILLOFACIAL SKELETON

1. Ball in hand appearance
Benign salivary gland tumors (sialographic appearance)
2. Balloon like appearance (Figure AP 1.1)
Follicular cyst
Aneurysmal bone cyst
3. Beaten metal appearance
Craniofacial dysostosis (Crouzon disease)

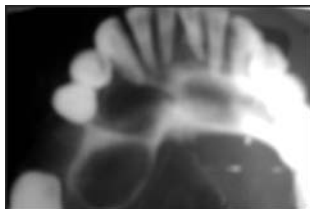


Figure AP 1.1: Balloon like appearance

4. Beaten silver
Fracture callus
5. Candle stick appearance
Progressive systemic sclerosis
Pyknodysostosis
6. Chalk like appearance
Osteopetrosis
Hyperparathyroidism
Pyknodysostosis
7. Cherry blossom appearance
Sjögren's syndrome (sialographic appearance)
8. Chicken wire appearance of enlarged marrow spaces
Thalassemia
9. Codmans triangle
Osteosarcoma
10. Cotton wool appearance
Paget's disease
Diffuse sclerosing osteomyelitis
Florid osseous dysplasia
Sclerotic cemental masses
Fibrous dysplasia
11. Cumulus cloud
Osteosarcoma
12. Driven snow appearance
Calcifying epithelial odontogenic tumor (Pindborg's tumor)
13. Egg shell appearance
Multilocular cyst
Ameloblastoma
14. Finger print/swirling pattern
Fibrous dysplasia
15. Floating teeth (floating in space) appearance (Figure AP 1.2)
Langerhans cell disease
Squamous cell carcinoma (involving alveolar bone)
Papillon Lefevre syndrome
Aggressive periodontitis
Fibrosarcoma
16. Ghost teeth appearance
Regional odontodysplasia
17. Ground glass appearance
Hyperparathyroidism
Fibrous dysplasia

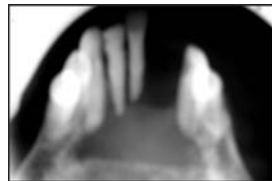


Figure AP 1.2: Floating in space appearance

18. Hair on end appearance
 - Sickle cell anemia
 - Thalassemia
 - Chronic iron deficiency anemia
 - Ewings sarcoma
19. Halo shadow effect
 - Periosteal reaction of the floor of the maxillary sinus resulting from extension of periapical infection
20. Hammered copper appearance (gyral or convolution markings on the skull)
 - Hypophosphatasia
21. Heart shaped radiolucency
 - Incisive canal cyst
22. Honeycomb appearance (Figure AP 1.3)
 - Ameloblastoma
 - Central hemangioma of bone
 - Odontogenic myxoma
23. Moth eaten appearance
 - Burkitt's lymphoma
 - Chronic suppurative osteomyelitis
 - Osteosarcoma (lytic type)
 - Osteoradionecrosis
24. Mottled appearance of the skull
 - Cushing syndrome
25. Onion peel appearance
 - Garre's osteomyelitis
 - Osteosarcoma
 - Ewing's sarcoma
 - Calcifying subperiosteal hematoma
 - Leukemia
 - Syphilis
 - Hypervitaminoses A
 - Caffey's disease
 - Metastatic Neuroblastoma
 - Fracture Callus
26. Orange peel appearance
 - Fibrous dysplasia
27. Pear or tear drop shaped radiolucency
 - Globulomaxillary cyst
28. Punched out appearance
 - Solitary plasmacytoma / Multiple myeloma

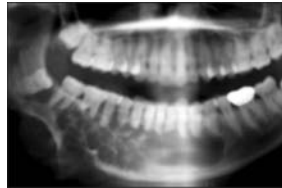


Figure AP 1.3: Honeycomb appearance

- Langerhans cell disease
- Metastatic carcinoma
- 29. Salt and pepper appearance:
 - Osteoblastic metastatic carcinoma
 - Hyperparathyroidism
 - Fibrous dysplasia
 - Osteoradionecrosis
- 30. Scalloped appearance
 - Odontogenic Keratocyst
 - Central giant cell granuloma
 - Traumatic bone cyst
- 31. Shattered wind shield appearance
 - Fibrous dysplasia
- 32. Soap bubble appearance (Figure AP 1.4)
 - Hemangioma
 - Aneurysmal bone cyst
 - Cherubism
 - Ameloblastoma
 - Giant cell lesion of hyperparathyroidism
 - Central giant cell granuloma
 - Odontogenic cysts like odontogenic keratocyst
 - Arteriovenous malformation
- 33. Stepladder appearance
 - Thalassemia
 - Sickle cell anemia
- 34. Sunray appearance (sun burst)
 - Osteosarcoma
 - Ewings sarcoma
 - Central hemangioma
 - Chondrosarcoma
 - Burkitt's lymphoma
- 35. Tennis racket appearance
 - Odontogenic myxoma
- 36. Washer effect
 - Compound odontome (intermediate stage)
(well- defined radiolucent area composed of number of radiopaque washer like cross-sections of developing teeth)
- 37. Wheel spoke pattern
 - Benign cementoblastoma



Figure AP 1.4: Soap bubble appearance

LIMITATIONS OF RADIOLOGY

(WITH SPECIFIC REFERENCE TO INTRAORAL RADIOGRAPHS AND ORTHOPANTOMOGRAPHY)

The dentomaxillofacial complex is susceptible to disease that manifests early as subtle changes in bone density and geometry. These changes can be detected by imaging. Conventional film based dental radiography is the defacto standard for clinical and research examination of the oral hard tissues.

Radiographic imaging is necessary only when the patient will potentially benefit by the discovery of clinically useful information on the radiograph. After concluding that the patient requires a radiograph the dentist should consider the most appropriate radiographic technique based on the anatomic relationship, size of field, radiation dose and the inherent limitations of the imaging technique used.

All x-ray transmission based radiographs suffer the limitation in that they are 2 dimensional projections of intrinsically complex 3 dimensional anatomies. The result is that buccal- lingual structures are indistinguishable. There is currently no traditional method of dental radiography that permits viewing internal dental anatomy without superimposition of other structures.

Soft tissues are not diagnostically imaged and for practical reasons the exposure settings, dose and level of detail are relatively fixed and represents a significant compromise. With these methods there is an acknowledged lack of sensitivity for detecting and quantifying small, subtle changes in the hard tissues.

CRITERIA FOR SELECTING AN APPROPRIATE RADIOGRAPH

Orthopantomogram

1. Orthopantomogram is preferred over intraoral periapical radiograph as a screening modality [to evaluate eruption status of teeth, to evaluate gross abnormalities of the maxilla, mandible and condylar process).
2. When required field of imaging is large.
3. When exposure to the patient is a factor.
4. When great image resolution is not a factor

INHERENT LIMITATIONS OF AN IOPA RADIOGRAPH

Periapical full mouth radiographs though more accurate than OPG in the dental area. It leaves a large area of maxillofacial skeleton unimaged and thus many lesions remain undetected.

INHERENT LIMITATIONS OF ORTHOPANTOMOGRAPHY

1. *Technique sensitive*
 - A. Patients with slumped heads and placement of neck forwards, causes a large opaque artifact in the midline caused by super imposition of cervical spine. These superimpositions can hide lesions particularly in the midline.
 - B. If the chin is tipped too low – teeth are severely overlapped and symphyseal region may be cut off in the film.
 - C. Patient should be instructed to swallow and hold tongue against the palate, Eliminating air spaces, thereby allowing optimum visualization of apices of maxillary teeth.
2. Fine anatomic detail is not obtained
3. Cannot detect small carious or periapical lesion.
4. Proximal surfaces of premolars typically overlap.
5. Uneven magnification and geometric distortion.
6. Clinically important structures that lie outside the plane of focus [focal trough] may appear distorted or may not be imaged at all.

ASSESSMENT OF MAXILLOFACIAL TRAUMA

1. Periapical radiographs and occlusal films though useful in imaging fractures of alveolar processes, because of high resolution. In some instances, it may be difficult to obtain these radiographs as a result of extent of injury and level of discomfort associated with mouth opening / jaw opening.
2. Injuries sustained in the midline of the maxilla /mandible may not be imaged well in an OPG because of super imposition of the cervical spine.
3. Zygomatico temporal suture often lies in the middle of the zygomatic arch and may simulate a fracture.
4. Air spaces between dorsum of tongue and soft palate simulate a fracture.
5. IOPA radiographs and OPG'S do not reveal the third dimensions of a fracture. If the x-ray beam meets the fracture plane 'enface' it

may not demonstrate the fracture. The beam must be aligned to meet the edge of the fracture plane at 90° or multiple projections may be necessary to reveal the fracture.

ASSESSMENT OF TEMPOROMANDIBULAR JOINT DISORDERS

1. OPG is considered a screening projection; subtle changes in the articulating surfaces cannot be assessed.
2. Glenoid fossa cannot be seen in plain radiographs because there is superimposition of skull base and zygomatic arch.
3. Because of the geometry of the OPG projection, the temporomandibular joints are distorted such that the medial condylar pole is projected superiorly which sometimes gives an erroneous impression of a condylar shape abnormality.
4. Condylar position and function cannot be assessed because the mandible is in a slightly open and protruded position in an OPG.

ASSESSMENT OF ALVEOLAR BONE FOR IMPLANTS

It is mandatory to evaluate adequacy of height of bone, thickness of bone, relative position of medullary and cortical bone and relative position of anatomic structures like mandibular canal, maxillary sinus to the implant site.

1. IOPA radiograph and OPG can supply information only regarding the vertical dimension of bone at the proposed implant site.
2. Only cross sectional imaging can provide details about the anatomical landmarks in relation to path of insertion of implant and anchorage for the implant.

ASSESSMENT OF MAXILLARY SINUS

1. IOPA film provides a detailed view of only the floor of the maxillary antrum.
2. OPG provides view of both maxillary sinuses and parts of inferior, posterior and anteromedial walls.
3. IOPA radiographs reveal only a small part of the maxillary sinus, hence they alone are not enough for reliable diagnosis of pathology within the antra.
4. OPG reveals cyst like findings better than cloudiness and sclerotic changes. [Soikonnen 1990; Akesson 1992]

ASSESSMENT OF PERIODONTAL DISEASES

1. OPG produces image distortion, hence not useful for detailed analysis of teeth and periodontium.
2. In a bitewing radiograph the extent of bone loss is not always visible, also the entire root and apex is not visible.
3. IOPA radiograph and OPG provide a 2D picture of 3D structures
4. Super imposition of one structure over the other
5. Extent of periodontal lesions under/over estimated.
6. Soft tissue landmarks and soft tissue attachment cannot be viewed.
7. Periodontal disease activity cannot be assessed
8. Small changes in angulations of the x-ray beam can produce large change in the resultant image.

ASSESSMENT OF CARIOUS LESIONS

1. Bite wings have limited success in caries diagnosis. 60% of lesions detected and 20% of non-carious tooth surfaces are diagnosed as having caries. [White 1984; Douglas 1986]
2. Due to projection factors, IOPA radiographs tend to under/over estimate degree of osseous destruction. [Akesson 1992]
3. Early carious lesions are difficult to detect especially so when they are confined to the enamel
4. Paralleling technique for obtaining IOPA increases the chances of detecting caries of both anterior and posterior teeth.
5. Pulp exposure cannot be determined by radiographs, only clinical evidence can substantiate the radiographic impression.
6. Occlusal carious lesions limited to the enamel is not ordinarily detected
7. Because of superimposition of heavy cuspal enamel over the fissured [carious] areas.
8. Super imposition of buccal carious lesions covers the occlusal area—simulating occlusal caries.
9. Approximately 40% of demineralization is required for radiographic detection of a lesion.
10. It is a challenging task to differentiate cervical burn out from proximal caries.
11. It is difficult to differentiate between, buccal lingual caries on a radiograph

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